THE SURGICAL TREATMENT OF PEPTIC ULCER

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Surgical treatment of peptic ulcer is a most fascinating subject, prominent in medical literature for more than fifty years. Peptic ulcer is a condition characterized by chronicity and by a tendency to recurrence. Its cause is unknown, and unfortunately we have no assured cure.

Hepburn[1] compares his more than thirty years of experience with the disease as against that of the thirty years war. He states that the treatment of peptic ulcer during this period has been one of strife between the internist and the surgeon. Early in the period, little or no surgery was performed in the East although a good deal was being done at the Mayo Clinic. Then came a swing of the pendulum toward surgery. The establishment of a diagnosis of peptic ulcer meant operation, usually a simple gastro-enterostomy. Influenced by poor results, unwise selection of cases, poor technical surgery, even operation where no ulcer existed, the pendulum swung the other way, and as usual, went to as great an extreme. The internist then rejected surgical treatment and treated the patient much too long, frequently until the lesion became malignant, before seeking surgical advice and treatment. Now the pendulum has swung back toward surgery. Medical man and surgeon now agree that a patient with a peptic ulcer is always a patient, he is never cured. He must live at a diminished tempo, must eschew alcohol and tobacco, and must follow a careful diet in order to avoid recurrence of the ulcer. Therefore, under proper dietary and habituary regime, successful, symptom free patients might better be called controlled, than cured.

Zollinger[2] states that there has developed during the last few years a better correlation of medical and surgical thought, resulting in a more uniform treatment of the disease. Close cooperation now exists among internist, surgeon and roentgenologist both for diagnosis as well as treatment and subsequent care of the patient. In contrast to fifteen years ago, when over one-half of the patients with ulcers were treated by surgical measures, surgery is now confined to those instances in which complications occur during medical treatment. This limits the number of surgically treated cases to 5 to 10 per cent of duodenal ulcers and approximately 20 per cent of gastric ulcers. With improving methods of medical treatment the number of patients requiring surgery may be even further decreased.

Priestly[3] reports that only 15 per cent of patients in whom the diagnosis of duodenal ulcer was made at the Mayo Clinic during 1938 were treated surgically. In contrast, in 1928 approximately 38 per cent of patients who had a diagnosis of duodenal ulcer underwent surgical treatment. It is, therefore, obvious that the medical management of duodenal ulcer gradually has been extended to include a larger number of patients. The fact that only 15 per cent of all patients who have duodenal ulcer are operated on at the present time means that the surgeon does not see the small, simple, innocent type of ulcer which he formerly encountered. For this reason alone the surgical management of duodenal ulcer necessarily must be altered in accordance with the type of lesion that is now encountered.

Jones[4] states that twenty years ago the treatment of ulcer was largely surgical. Since that time there has been a definite shift toward medical therapy, not from the point of view of curing the disease, but from the point of view of the management of a chronic recurrent condition. More recently, however, there has, I think, been a trend away from indiscriminate medical treatment and toward well-planned surgery in cases with accepted indications for surgical interference. The exact

and proper percentage of cases requiring surgical interference is still to be determined, but there is no doubt that it should include about 20 per cent of all cases.

The term peptic ulcer was first applied by Quincke[5] to duodenal and gastric ulcer because of the general similarity of the two lesions and because they are found in the region of the stomach which is bathed with acid chyme.

Etiology

The origin and persistence of peptic ulcer has been the source of much speculation and experiment. Most observers agree that the action of gastric juice plays an important part in the development and the chronicity of the ulcer, but there have been many theories advanced for the initial and predisposing cause. It is apparent that there is an underlying cause for the origin and persistence of peptic ulcer, aside from the contributing effect of the digestive action of gastric juice.

The theories which have been advanced regarding the initial cause of peptic ulcer may be classified according to whether or not the initial lesion is regarded as inflammatory, neurogenic, circulatory, bacterial or digestive. The principles embodied in these theories have been claimed to act either independently or in combination, in producing the acute ulcer and determining its chronicity.

Pathology

The development of surgical technique has greatly increased the extent of surgical treatment and has afforded opportunity for the pathologic study of peptic ulcers.

MacCarty[6] reviewed ninety-two pathologic specimens of inflammatory lesions in the duodenum. In such sections he invariably found cellular destruction, with congestion, edema, and immigration of polymorphonuclear leukocytes, lymphocytes and endothelial leukocytes.

Serosal changes, when these lesions were localized, were indistinguishable from those of small ulcers. Judd[7] described a "duodenitis type of ulcer" which he distinguished from the usual duodenal ulcer by the absence of a distinct crater. Nagel and Judd,[8] after studying a series of these lesions, found that duodenitis, in its mildest form, is noted as a small, circular patch, in which there is hyperemia and faint stippling. In more severe forms of this condition the affected regions are red, edematous, and the stippling is marked. In advanced cases, the duodenum, for a few centimeters, may be uniformly narrowed. The mucosa may present single or mutiple superficial erosions. The duodenal wall, in the affected region, is usually somewhat thickened. In a microscopic section, all the changes found in subacute and chronic inflammatory processes are seen.

Since gastroenterostomy has become such a common procedure in the surgical treatment of peptic ulcer, opportunities have been afforded for the study of occasional acute shallow lesions which occur in the jejunum or about the stoma made at gastroenterostomy. These present the usual pathologic pictures seen in acute duodenitis or gastritis. Sometimes the lesions present superficial, localized, inflammatory portions; again, hemorrhagic patches or erosions around the anastomotic opening may be distinguishable.

Acute ulcers, in all probability, are closely related to gastric and duodenal erosions. Some authorities prefer to consider them separately, designating erosions as lesions involving only the mucosa, whereas acute ulcers involve the submucosa or even the serosa. Like erosions, acute ulcers are frequently multiple. They are usually round or ovoid; occasionally, because of fusion with other ulcers, the shape is irregular. The margins are usually smooth and regular and have a punched-out appearance. If the ulcer is at all deep, it has a terraced appearance, due to the fact that the apertures in the different coats diminish from within outward.

The tendency is for these lesions to heal rapidly, leaving small mucosal scars. Not infrequently, however, hemorrhages result because of extension of the eroding process through the wall of a blood vessel. The ulceration may stop in the muscular coat, or extend to the peritoneum, resulting in localized or general peritonitis.

Microscopically, there is necrosis of tissue at the bases of these ulcers, a mild degree of inflammatory reaction in the neighboring tissues, infiltration with round cells, and an abundance of polymorphonuclear leukocytes. There may be much swelling of the tissues and some thickening due to hyperplasia.

Chronic ulcers of the stomach may be single or multiple. In most instances only one active ulcer is demonstrable. In the duodenum, however, ulcers are frequently multiple; two active, chronic ulcers are often demonstrable, one on the anterior, and

one on the posterior wall. When the bowel is empty, such lesions are frequently in exact opposition, which has led to the terms "contact" or "kissing ulcers."

Gastric ulcers are most frequently found on the lesser curvature, on the posterior wall, in the antrum, and in the pyloric portion of the stomach. Ulceration is more common in the duodenum. Chronic ulcers of the duodenum usually are found within 1½ inches (3.8 cm.) of the pylorus. The posterior and anterior walls are involved with almost equal frequency. Occasionally an ulcer may almost encircle the duodenum; rarely, it extends to and involves the pylorus.

Gastric and duodenal ulcers are sometimes combined. When ulcers are in combination they have a much greater tendency to occur either in the pyloric portion or close to the lesser curvature. In either position they are more frequent on the posterior surface. All chronic ulcers are more common in men than in women, but this tendency is more marked with duodenal than with gastric ulcers.

The size of gastric ulcers is variable. They are usually rounded or oval in contour; occasionally they are saddle-shaped. Large, chronic, indolent ulcers are generally shallow. Usually these ulcers have a funnel-shaped or terraced appearance. Later, as the lesion becomes more chronic and as there is more invasion and infiltration of tissue in the depth of the lesion, a globular crater is formed. The edges of this are overhanging and cirrhotic. In definitely active lesions the margins are red and edematous; in old, inactive lesions the margins are paler. There is evidence of neighboring induration.

In chronic ulcers the necrotic process usually has penetrated the muscular coat of the gastric wall. The crater of the ulcer may be filled with mucopurulent material. The base of the lesion is made up of fibrous and granulation tissue. Extension of the ulcerating process to the serosa causes inflammatory reactions surrounding the wall of the viscus; this results in adhesions between the base of the ulcer and the liver, the pancreas, or some other neighboring organ. Further extension of the ulcerating process occasionally occurs, resulting in the formation of a new bed for the lesion in the tissue of the organ to which it has become attached. If the eroding process is very rapid, adhesions cannot form and the ulcer perforates into the abdominal cavity. If the progressively extending ulcer erodes a blood-vessel, bleeding occurs.

Signs of malignancy in gastric ulcer are not uncommon. Such a finding is more common in the larger ulcers and in ulcers occurring near the pylorus or on the greater curvature. Benign and malignant ulcers may coexist in the same stomach. Microscopic investigation of chronic ulcer shows the overhanging mucosa to contain an excessive number of lymphocytes. Usually, polymorphonuclear leukocytes are absent, although there is practically always proliferation of the epithelial cells, with an attempt to cover over the denuded area. This proliferated tissue is destroyed by the inflammatory and fibroblastic reaction. The edges are undermined and the base usually contains necrotic tissue or fibrin into which capillary loops are penetrating, forming granulation tissue. Lymphocytes are abundant, and masses of them extend considerable depths into the surrounding tissues; the excessive fibroblastic and fibrous tissue reaction gives the tissue the indurated appearance.

Chronic duodenal ulcers are usually smaller than gastric ulcers. Occasionally they may become large. Their shape is variable, they may be extremely irregular, although more commonly they are round or oval. As a rule, duodenal ulcers are shallower than gastric ulcers. This is probably because the wall of the deodenum is thinner than that of the stomach. The mucosa of the borders of the duodenal ulcers usually is not of abnormal thickness, and often it does not project over the crater.

Duodenal ulcers cause obstruction more frequently than do gastric ulcers. An ulcer of the duodenum, in close proximity to the pylorus, occasionally involves the sphincter, thus causing retention. This is most frequently due to edema, but occasionally cicatrization is the cause of the obstruction.

Chronic duodenal ulcers usually are similar in general histopathologic characteristics to gastric ulcers. The ulcer may have a punched out appearance. At times it is indurated, and its walls may have a terraced appearance. The walls of a duodenal ulcer are seldom calloused, as are those of a chronic gastric ulcer. Penetrating characteristics are frequently noticed in duodenal ulcer; the deeply eroding ulcer may cause adhesion between the posterior wall of the deodenum and the surrounding tissue. Microscopic investigation of chronic duodenal ulcer reveals cystologic conditions similar to those noted in chronic gastric ulcer. Carcinoma, however, is not found in duodenal ulcer. In chronic

duodenal ulcer the base is often in the head of the pancreas. This penetration into the pancreas and the erosion of the pancreatic arteries leads often to profuse hemorrhage, although thrombosis usually occurs before the blood vessels are eroded and ruptured. Thrombosed vessels are commonly found in the bases of chronic duodenal ulcers; less commonly in chronic gastric ulcers.

Occasionally, following operations in which the jejunum was anastomosed to the stomach, inflammatory lesions develop around the stoma, or in the jejunum just below the opening made at gastroenterostomy. If these ulcers are below the anastomosis, they are called jejunal ulcers; if they are in the area of anastomosis, they are referred to as gastrojejunal ulcers. Operative procedures undertaken to cure a gastric ulcer are less likely to be followed by such ulcers than are those in which the original ulceration was in the duodenum. Jejunal ulcers following operations for carcinoma are extremely rare. Such ulcers are seen fifteen times more frequently in men than in women. Shallow, inflammatory mucosal lesions, with or without erosion, occasionally are demonstrable about the stoma or in the jejunum. Acute ulcers, which are likely to bleed or perforate, may result. Histologically, such lesions resemble duodenal ulcer. Perforation into the colon is not a rare complication of jejunal ulceration.

Acute anastomotic ulcer resembles acute gastric ulcer. It usually has a punched-out, round or ovoid appearance; if situated about the stoma, it may be irregular in outline. It may extend rapidly through the wall of the jejunum, which is thin, thus precipitating peritonitis. The rapidity with which the lesion spreads may prevent adhesions from forming about the serosa, thus leaving it free to penetrate into the peritoneal cavity. This complication occurs more frequently following anterior gastroenterostomy.

Chronic anastomotic ulcer resembles, in most respects, other peptic ulcers. The complication of perforation is more likely to develop from jejunal ulcers than from gastrojejunal lesions. Occasionally a jejunal ulcer will cause obstruction from cicatrization, but more frequently because of acute inflammatory reaction.

Ulcers which are close to the anastomosis may become extensive and involve the entire stoma. Not infrequently, the transverse mesocolon furnishes the base for the ulcer. Occasionally it perforates directly into the colon, producing a gastrocolic fistula.

Physiology

Food taken into the stomach immediately arranges itself along the greater curvature and is piled up in layers. At first there is but little motion, and not infrequently the ptyalin from the salivary glands continues its actions in the cardiac portion of the stomach on any starches that have been ingested. Ptyalin acts not only in an alkaline but in a neutral medium as well, but its activity is destroyed by an acid medium. Peristalsis apparently begins about the middle of the body of the stomach and proceeds toward the pyloric end; according to Cole, in cycles which consist of a period of contraction, called a systole, and a period of dilatation, called a diastole. The systole takes seven-tenths of the period of the whole cycle which lasts two or three seconds. As a rule the stomach has four cycles, so there are four waves of contraction with intervening diastoles, which may be seen at the same time. When peristalsis is initiated the cardiac end of the stomach becomes tonically contracted so that the left half is largely converted into an elastic hopper, making pressure upon the food and forcing it towards the pylorus. If the peristaltic waves are sufficiently strong and go over the pyloric canal, there is a slight relaxation of the pyloric spincter and a small thin stream of the gastric contents is squirted into the duodenum. This accumulates for a while in the first portion of the duodenum and forms a cap which is emptied by later contractions harmonizing with the contractions of the duodenum below.

In the stomach the proteins are acted upon by hydrochloric acid and pepsin and become acid albumin or syntonin, and by a continuance of this process become primary and secondary proteoses and peptones. Little is absorbed through the stomach except water, some of the mineral salts, a little of the highly concentrated sugars and alcohol, which is absorbed chiefly through the stomach.

The mechanism of the emptying of the stomach has been the subject of considerable discussion. According to Pavlov and Cannon[9], it is due partly at least to a chemical control; when the contents of the stomach are excessively acid the pyloric spincter relaxes and when the contents of the duodenum are acid the pyloric sphincter automatically contracts. This does not explain a case of achylia in which there is no acid in the stomach, or the rapid emptying of water and white of egg which seems to go quickly along the lesser curvature into the duodenum.

Carlson[10] has shown that any irritation of the mucosa of the upper portion of the duodenum tends to cause a reflex closure of the pyloric sphincter, whether this irritation is due to excessive acid, excessive alkali or mechanical trauma. According to the observations of Cole, Luckhardt, Phillips[11] and others, it seems that every peristaltic wave that reaches the pyloric sphincter causes some relaxation of the sphincter and consequently a slight opening. The waves that do not quite reach the sphincter do not effect this opening.

Alvarez[12] thinks that the emptying of the stomach and intestine is due to a gradient and that there is normally more rapid movement of muscles in the oral portion of the stomach than in the distal portion. Klein[13] believes that the normal conductivity of gastric peristalsis is dependent upon the lesser curvature and that the contracting ring which constitutes gastric peristalsis follows a stimulus along the various segments of the lesser curvature.

When a circular sleeve resection of the stomach is done, there seems to be an independent rate of contraction in the pyloric portion, which is much slower than that in the cardiac portion. Klein thinks that the antrum of the pylorus has a separate nodal center for its control, which largely directs the peristalsis after a sleeve resection, but this has not been proven histologically.

This recent work is significant in showing the importance of preserving wherever possible the lesser curvature of the stomach, and, when it is necessary to do a sleeve resection to align the lesser curvature of the two gastric stumps accurately without regard to the position of the greater curvature. When the pyloric portion of the stomach is removed the lesser curvature should be placed in alignment with the upper border of the duodenum.

The secretion of gastric juice is caused first by the afferent stimuli from the sensorium of the brain, arising from the sight or thought of food as well as by the influences that proceed from the tongue and pharynx in contact with food. This is called the "appetite gastric juice" and it is secreted rather rapidly before the food reaches the stomach. After touching the gastric mucosa, however, food seems to be a direct stimulation for gastric juice. The nature of this stimulation is not known. In 1906 Edkins reported a hormone secreted in the pyloric mucosa, occasioned by the presence of food and acid gastric juice in contact with this mucosa, and that this hormone was absorbed in the blood and stimulated the secretion of gastric juice. This theory of Edkins has been used as a reason for pylorectomy in order to eliminate this gastrin and so diminish the secretion of gastric juice. Carlson, Luckhardt, Ivy and others have not verified Edkins' findings, which would seem, therefore, not to afford a proper basis for pylorectomy. There is something, however, in food or some substance formed by contact of the food with the gastric mucosa which does cause an increase in the gastric secretion. This appears to be formed to a large extent throughout the stomach and is not specific. Similar substances obtained from spinach, strawberry leaves, gastric juice, and various other sources, when injected subcutaneously will increase the secretion of gastric juice. Pressure doubtless causes secretion of gastric juice in addition to stimulating peristalsis.

After observation of several individuals in whom there was a gastrostomy on account of a cicatricial closure of the oesphagus, Carlson has shown that there is continuous gastric secretion, instead of an absence of secretion when the stomach is empty as has been generally supposed. When there is no food in the stomach, however, the secretion is at a very much slower rate than after meals. Carlson thinks that the effect of gastric juice has been exaggerated and that there is no such thing as hyperchlorhydria. The upper limit of normal in hydrochloric acid secretion of the stomach is 0.5 per cent, which tends to vary from that point down. Carlson has often drawn off the "appetite gastric juice" and introduced food with no ill effect in patients with gastrostomy. It is doubtful, however, whether this could be continued indefinitely and health maintained, if for no other season than that the hydrochloric acid is the chief antiseptic element in the gastric juice and tends to destroy or inhibit the bacteria in the upper gastro-intestinal tract, Carlson thinks that the so-called hyperchlorhydria is due merely to increase in the quantity of gastric juice, this in turn caused by the excessive stimulus of the prolonged presence of food in the stomach. As is well known, the most active and continuous stimulus of gastric juice is food in the stomach, the proteins of meat having a particularly stimulating effect.

When there is an obstruction of the pyloric end of the stomach, either from an organic stricture or a spasm, the prolongation of the contact of the food with the gastric mucosa is very marked and produces a continuous stimulus for the formation of

gastric juice; consequently an excessive amount of gastric juice accumulates in the stomach. If the stomach can empty satisfactorily, when the food is expelled the stimulus to the secretion of gastric juice is removed to a large extent. In cases of pyloric or duodenal ulcer in which there is spasm of the pylorus, the stomach appears at first to empty more rapidly than normal and then later there is retention. This is due to the fact that the powerful contractions of the full stomach at first overcome the obstruction of the spasm of the pylorus; but after the stomach has partially emptied, the force of the peristaltic wave is weakened and does not seem to have the power to overcome the pyloric spasm; consequently there is a residue of food retained longer than normal and this residue continues the stimulation of the gastric mucosa which produces more gastric juice.

Clinical Applications of Physiology

These physiologic facts, many of recent determination, afford the underlying principles of gastric and duodenal surgery. First, it can be said that the routine use of gastroenterostomy for all stomach lesions is illogical. Gastrectomy has a definite field in which no other operation is quite so satisfactory; but in cases in which there is an extensive duodenal ulcer or a cicatricial contraction of the duodenum or the pylorus, gastro-enterostomy is an excellent operation. The contraction prevents the exit of gastric juice through the pylorus so that the high alkalinity of the duodenal contents protects the mucosa of the jejunum from the acid of the stomach as it is emitted through the gastroenterostomy stoma. In an open pylorus, however, in which part of the contents of the stomach comes through the pylorus and part through the stoma, the jejunum is unprotected and jejunal ulcer frequently results. In small isolated duodenal ulcers without adhesions some form of pyloroplasty seems indicated.

When a resection of the stomach is considered it must be recalled that the pyloric portion of the mucosa secretes alkaline and not acid material. While some type of hormone is produced by contact of food with any part of the gastric mucosa, there is no specific hormone created in the pyloric mucosa; hence pylorectomy to reduce the supply of such a hormone and so decrease the acidity of the gastric juice is not founded on proven physiologic facts.

The reduction of acidity which is considered an indication in surgery for peptic ulcer, may be obtained by eliminating the physiologic obstruction at the pylorus, thus shortening the emptying time of the stomach. This can often be accomplished by a pyloroplasty, or if there is an organic obstruction, by a gastro-enterostomy. Partial gastrectomy is indicated if there is a marked gastritis, particularly in the pyloric portion of the stomach, and if the ulcer is gastric. After gastrectomy it should be remembered that the lesser curvature represents the original gastro-intestinal tract and is highly important. The longitudinal fibers in this region so contract as to form a channel along which fluids travel from the cardia to the pylorus. The axis of the peristaltic waves is largely in this region, and as the lesser curvature represents a much shorter distance between the cardia and the pylorus than the greater curvature, it is capable of less motion. An important reason too, as Alvarez and Klein have pointed out, is that impulses for gastric peristalsis appear to emanate from the lesser curvature. For all of these reasons it is essential, when a gastrectomy is done, either a sleeve gastrectomy or resection of the pyloric portion, that care should be taken to make the proper relations along the lesser curvature of the stomach, even neglecting the greater curvature. This will tend to restore function more nearly than if attention is centered more on accurate union along the greater curvature.

The pyloric mucosa, which secretes alkaline material, is more subject to peptic ulcers than is the portion of the gastric mucosa that secretes acid. Any peptic ulcer of long standing in the pyloric portion of the stomach creates considerable gastritis in its neighborhood. For these reasons gastrectomy is more strongly indicated for gastric ulcer than was formerly thought; also because less radical operations such as gastro-enterostomy or pyloroplasty are not so effective in curing gastric ulcer as in curing duodenal ulcer. It is best to go well into the cardiac side of the stomach in doing a pylorectomy. This not only eliminates the pyloric mucosa which is prone to ulceration but also removes some of the acid-secreting gastric mucosa.

When possible the stump of the stomach should be united to the duodenum. This is the normal physiologic emptying point for the gastric contents and it should be preserved if there is no special contra-indication. A modified Billroth I operation

is applicable in many cases. In this procedure the stump of the stomach is united along the lesser curvature to the upper border of the duodenum and the duodenum is flared open by an incision of about one inch in its anterior surface. When so much of the stomach has been removed that the cardiac stump cannot be approximated to the duodenum, it seems probable that all the portion of the stomach concerned in active peristalsis has been excised. It must be recalled that peristaltic waves seem to begin about the middle of the body of the stomach, whereas the cardiac end remains in tonic contraction. With tonic contraction instead of peristaltic waves there is not the same indication for preserving an axis of peristalsis so that an opening may be made along the greater curvature if all of the left half or two-thirds of the stomach has been removed. This is done by the anterior Polya operation, the Polya-Balfour operation, the original posterior Polya, or the Hofmeister modification of the Billroth II gastrectomy, in which the lower portion of the stump of the stomach is united to the jejunum while its upper part is folded in and sutured.

The anterior Polya operation is often satisfactory, but the necessity of placing long limbs of jejunum over the transverse colon has its obvious objections; it creates potentialities for obstruction or volvulus; and if an entero-anastomosis is made between the limbs, some of the alkaline duodenal contents that protect the mucosa of the jejunum are deflected and may leave unprotected that part of the jejunal mucosa opposed to the stomach, resulting in a jejunal ulcer.

The experiments of Mann and Williamson[14] show that peptic ulcer occurs in dogs in a large percentage of experiments in which the duodenal contents are diverted from a segment of the small bowel united directly to the stomach. This seems to have a clinical application. The Roux gastro-enterostomy, in which the jejunum is divided, the distal end united with the stomach and the proximal end sutured to the side of the bowel lower down, would appear to deflect the alkaline duodenal contents entirely, except for some regurgitation. Such operations seem prone to form ulcer, because of the removal of the physiologic protection of the alkaline duodenal contents. An entero-anastomosis in an anterior Polya operation does not deflect all of the duodenal contents; but certainly an operation

in which the jejunum is divided and the distal end applied to the stump of the stomach and the proximal end applied end-to-side lower down would appear to establish exactly the conditions in which Mann and Williamson found that peptic ulcer often occurred in dogs.

After gastric operations, rest should be secured by giving as little food as possible and that of a kind requiring a minimum of work by the stomach. The protein of meats stimulates both peristalsis and the secretion of gastric juice; carbohydrates and fats, on the contrary, are not at all affected by the gastric juice. When it becomes necessary to give food after an operation upon the stomach, partial rest can best be secured by giving the type of food that stimulates both peristalsis and secretion as little as possible; hence proteins in the form of meat should be avoided and the food should consist largely of fats such as cream, and carbohydrates given in a non-irritating form. The protein of milk stimulates the stomach less than that of meat. In this manner nutrition is provided while imposing a minimum amount of work on the stomach and the maximum degree of physiologic rest to the traumatized tissues is secured.

From these facts it may be seen that both the operative technique and the after-treatment of gastric cases should be based on a consideration of normal physiologic function.

Indications for Operation

Ordinarily peptic ulcer does not endanger life. It is seldom that any operative procedure is necessary for an acute peptic ulcer. The results of careful, competent, medical management are eminently satisfactory in many cases of uncomplicated duodenal and gastric ulcer. This is particularly true in those instances in which the symptoms are of short duration, but it tends to become less true after chronicity has been established. It is important to consider the presence or absence of complicating factors before operative procedures can be justifiably advised.

After considering the above mentioned facts and consolidating the opinion of a large number of surgeons it appears that the surgical treatment of an uncomplicated peptic ulcer is indicated only after all forms of medical treatment have been exhausted. This requires proper teamwork between the internist, roentgenologist and surgeon. Many state that under proper medical management, ap-

proximately eighty per cent of the cases will be controlled. The remaining twenty per cent comprise the complications, and it is this group that may become full of serious possibilities. The early recognition of complications, therefore, is of great importance.

In our discussion let us limit the complications requiring surgery to perforation, pyloric obstruction, certain instances of profuse hemorrhage, failure of medical management, and a suspicion of cancer. Let us now take up each one in order.

1. PERFORATION

Acute perforation of a duodenal or gastric ulcer constitutes a serious abdominal emergency usually characterized by such clinical manifestations that the urgency of surgical intervention is immediately apparent. In the case of acute perforation of a peptic ulcer, operation is performed as a life saving measure and embraces only one objective, that of closure of the perforation. Although simple closure of the perforation does not provide the patient with assurance against recurrence, the surgeon's responsibility in the emergency is not that of a permanent cure of the ulcer. Experience has by this time proved very conclusively that usually a more extensive surgical procedure than closure of the perforation mitigates against recovery. Departure from the policy of simple closure of a perforation is seldom justified even though symptoms of ulcer recur in a large percentage of patients and secondary operation curative in nature is often required. In spite of the fact that the time interval between perforation and surgical closure bears a distinct relation to the mortality rate of perforation, Graham[15] has deliberately prolonged this time interval in certain instances by as much as eight hours for purposes of instituting pre-operative treatment of shock and secondary manifestation of the perforation with profit to the patient. He has recently reported fifty-one consecutive operations for perforated duodenal ulcer with but a single fatality.

Lahey's[16] experience with these cases bears out the opinion of others that the surgeon's obligation to a patient at a time when the ulcer perforates is to get him through alive. He gives sound reasons for this. Not all patients with perforated duodenal ulcers can be operated on so early that the hazard to life from merely closing the ulcer is not considerable. One cannot add the risk of gastro-enterostomy or subtotal gastrectomy in the presence of a perforated ulcer without materially increasing the mortality rate. In addition to that, many patients with perforated duodenal ulcers have never had a really adequate trial of medical management before the perforation occurred. Under these conditions one would subject a patient to a major surgical procedure without being certain that the ulcer could not have been managed medically after the perforation had been closed. It is clear that our first obligation is to save the patient's life by simple closure of the ulcer, unless this produces obstruction. Our next obligation is to determine by an adequate trial of medical management, after the patient has recovered from the perforation, whether the ulcer can be healed without operation. Then, should medical management fail, radical operation in the form of subtotal gastrectomy should be carried out, if the patient's general condition and the location of the ulcer permit.

There is a feeling in this country that in the great majority of cases the addition of any procedure to that of simple closure will in the long run raise the mortality rate. Several foreign surgeons, however, advocate radical resection for perforation. Evaluation of mortality figures is difficult because they operate only in good risk patients with a very short duration of perforation. Some reports advocating resection for perforation have been made in this country, but the method was abandoned because the mortality rate did not justify the procedure.

For a time gastro-enterostomy with closure of the perforation was a popular method of treating the indurated type of ulcer because this type of ulcer occasionally caused obstruction at the pyloric outlet. This method of treating perforated ulcers lost favor, because it increased the mortality rate and the possibility of post-operative sequelae. It is clearly indicated in the recent literature that there has been too much fear of obstructing the polyrus following closure alone. With the use of constant gastric suction it is now apparent that troublesome acute post-operative obstruction of the pylorus is infrequently encountered despite the fact that at the time of operation the duodenum may appear to be occluded.

2. PYLORIC OBSTRUCTION

Obstruction usually occurs after the ulcerating process has been present for some time. Acute ulcers rarely cause obstruction. Gastric retention

when due to the edema of re-activation of ulcer usually is temporary and subsides under medical treatment, but tends to recur.

The more chronic forms of ulceration are often associated with scar tissue which causes stenosis by contraction. The more important deformities caused by contraction of the cicatrix are stenosis of the pylorus with resultant obstruction and dilatation of the stomach, approximation of the cardiac and pyloric orifices by the healing ulcers on the lesser curvature, hour-glass stomach produced by the cicatrization of saddle ulcers or multiple ulcers extending around the stomach, and more rarely, stenosis of the cardiac orifice. Occasionally, an ulcer in the stomach a considerable distance away from the pylorus is capable of producing definite retention of gastric content. Peptic ulcer of the stomach or duodenum may cause retention by producing spasm of the pylorus. Extension of inflammation from an ulcer contiguous to the pylorus may involve the sphincter, causing periodic retention. In periods of definite activity retention may develop, and then disappear during intervals of quiescence of the ulcer.

Emery and Munroe[17] and others have pointed out that the great majority of patients with 100 per cent retention at one examination is not an indication for surgery. Such patients when placed on strict medical treatment consisting of alkaline therapy, antispasmodics, and aspiration will recover without surgery. It is only when retention of 40 per cent persists or recurs on adequate medical treatment that surgery is recommended. Persistence or recurrence of gastric retention due to true cicatricial pyloric stenosis of a duodenal ulcer or to a disturbance of gastric motility in the presence of a gastric ulcer is amenable only to surgical treatment.

3. HEMORRHAGE

Hemorrhage is one of the more serious complications of peptic ulcer and next to perforation the commonest cause of death. Acute massive hemorrhage as a rule is not an indication for surgery. The bleeding peptic ulcer represents a serious problem to both the internist and the surgeon. Quite frequently the question arises as to whether medical management shall be relied upon or whether an operation shall be performed. It is well known that bleeding occurs in from 20 to 35 per cent of the cases of peptic ulcer. In many instances the bleeding is manifest through persistence of a secondary anemia and the presence of occult blood in the stool. As a rule these cases provide no serious problem because no emergency exists. Should healing of the ulcer with resultant disappearance of blood from the stool and improvement in the blood picture not follow careful medical management, an operation of election may be necessary. The massive exsanguinating type of hemorrhage constitutes a serious emergency. Occasionally one or repeated hemorrhages occurring in patients otherwise well may be so severe as to threaten life, and the question of operation then has to be considered.

Death from exsanguination occurs in from 10 to 15 per cent of the patients who suffer with massive hemorrhage from a peptic ulcer. Goldman[18] and others emphasize the fact that too many physicians believe gross hemorrhage from an ulcer is rarely fatal and adopt a policy of watchful waiting. Allen and Benedict,[19] among others, have emphasized the observations that the danger of a fatality rises rapidly with advancing age and is materially higher in patients beyond the age of fifty years than in younger individuals. Recovery from a massive hemorrhage offers no assurance that subsequent bleeding from a duodenal or gastric ulcer will not occur. Means[20] has directed attention to the observation that as the mortality from massive hemorrhage increases with age, so, too, does it increase with each recurrence.

Hunt[21] points out that many surgeons and internists subscribe to the folowing policy in the treatment of massive hemorrhage from peptic ulcer: (1) In the treatment of massive hemorrhage from peptic ulcer, whether primary or recurrent, one of the most important measures is transfusion for the purpose of restoring blood volume. (2) In the patient under fifty years of age operation seldom if ever is indicated during the hemorrhage. (3) Repetition of massive hemorrhage two or more times in patients under fifty years of age warrants surgical intervention as soon as the patient's general condition will permit an operation of election with a maximum degree of safety. (4) In patients more than fifty years of age, operation is advised in those patients who show no improvement as the result of intermittent, repeated or continuous transfusion in from twelve to twenty-four hours. (5) In patients more than fifty years of age who have recovered from a massive hemorrhage through the

employment of non-surgical measures, fate should not again be tempted, but surgical measures advised.

Acute massive hemorrhage from a peptic ulcer which is not subsiding is a most dramatic situation. When matters proceed from bad to worse and the bleeding continues under non-surgical treatment including the transfusion of blood, early surgical attack directly upon the bleeding lesion even though the hazards are great, may provide the only life saving method. Surgical treatment during active hemorrhage from an ulcer embraces two important principles: that the operation be a direct one with excision of the bleeding lesion, and that the operation be performed early. Finsterer,[22] Gordon-Taylor, and others emphasized the importance of an early operation, one performed within twenty-four or forty-eight hours.

In general the mortality rate following surgical intervention for massive hemorrhage from peptic ulcer has been largely in excess of the mortality when treatment has been entirely by non-surgical measures, because it has been the mortality of surgical procedures instituted late in the cases of medical failure, and not the mortality rate of early surgical treatment in all cases of bleeding ulcer. Finsterer has recently reported only three deaths following gastric resection in seventy-one cases of bleeding ulcer, a mortality rate of 4.2 per cent.

Surgeons writing on the problem of the treatment of gastric or duodenal hemorrhage from ulcer invariably make a plea that they be consulted early and that the responsibility of deciding upon surgical therapy be divided equally between the surgeon and the internist at the onset of the hemorrhage. By such cooperation it is hoped that a better decision as to the time for surgery, if indicated, can be made, and that surgery will not be considered a final gesture to be employed only after the failure of medical treatment.

In young persons surgery may be withheld to see if, under medical treatment, the ulcer crater will entirely heal and the patient will remain symptom free. Otherwise, resection is, as a rule, wise after the patient has recovered from the acute blood loss. Surgery is indicated in patients having recurrent hemorrhage on adequate medical treatment, regardless of age, since it has been emphasized that there is an abrupt rise in mortality following the second hemorrhage.

Schindler[23] believes that gross hemorrhage is one of the most important indications for gastroscopy. As soon as possible after the patient has recovered sufficiently, x-ray examination and gastroscopy should be carried out. By gastroscopy the source of the hemorrhage may be revealed, such as that from tiny hemorrhagic erosions, small ulcerations in hypertrophic gastritis, and similar lesions which are not shown by x-ray.

4. Failure of Medical Management

From the internist point of view, Jones states that the most difficult decision in ulcer therapy is that of advising surgery because of the failure of medical treatment. Blahd[24] has found that if an ulcer shows a crater formation, and a small amount of barium is retained in the depths of the crater, it is intractable to medical treatment and operation should be performed. The individuals coming under this classification usually have severe pain not relieved by medication, rest, or diet, and which is without intervals of relief or periods of remission. These patients frequently have a high acid value. Surgery in these instances should be undertaken with the idea of giving the patient more adequate protection against recurrences. It is in this group that the argument between the conservative versus radical operative procedures is most heated. During the last two years the reports indicate strongly that the surgeons recommending radical procedures are more numerous.

5. A Suspicion of Cancer

Malignant degeneration or a suspicion of cancer is definitely a threat in all ulcer patients and may be called an indication for surgery. Since the incidence of cancer of the duodenum is so small, it is thought that an ulcer never becomes malignant in this region.

Malignant degeneration was first suggested by Cruveilhier[25] in 1839. The tendency of gastric ulcers to become cancerous has been commented on repeatedly by pathologist and surgeon since that time. That ulcers of the stomach may be the origin of carcinoma seems definitely established. It is of considerable importance to the surgeon, inasmuch as his treatment of gastric ulcer must be profoundly influenced by his opinion of the proportion of simple ulcers in which this carcinomatous change may be expected. The surgeon who believes that this proportion is over 50 per cent

will advocate more radical procedures than the surgeon who believes it is less than 5 per cent.

Cabot and Adie[26] have recently reviewed the trend of opinion on this subject, and have shown the fluctuations of surgical opinion on the estimated percentage. From their article it is found that of eighty-two reports, seventy-four authors believe that less than 10 per cent of gastric ulcers develop carcinoma; while fifteen believe the frequency to be over 50 per cent.

Alvarez and McCarty[27] have shown that the size of the ulcer may give some clue regarding its potentiality of becoming malignant. They showed that 23 per cent of the carcinomas resected at the Mayo Clinic are within the size of benign ulcers. They stated further that if an ulcer is larger than 3 cm. in diameter, it is almost certain carcinoma. Small carcinomas of the stomach may be productive of a syndrome which clinically is with difficulty distinguished from peptic ulcer.

Clinical evidence has been furnished by many observers and there are definite examples reported in which carcinoma has been preceded by a long history of ulcer. A very sound objection to inferences drawn from this is the difficulty not uncommonly encountered in differentiating gastric from duodenal ulcer. Several authors claim that the transition from simple ulcer to carcinoma is marked by the change from hyperacidity to anacidity, the appearance of a tumor, and cachexia in the course of long observed cases. Lockwood,[28] in one hundred and seventy-four cases of gastric carcinoma, found a suggestive history of ulcer in 7 per cent, definite in 3 per cent. Less than 5 per cent of carcinomas developed in three hundred and forty-six ulcers of the stomach treated by medical measures and observed by Greenough and Joslin,[29] and by Hemmetor.[30] Joslin[31] later published figures showing that 24 per cent of the late deaths following operation for gastric and duodenal ulcers were from cancer of the stomach. Balfour[32] reports that in seven hundred and ninety-nine cases operated on for gastric ulcer at the Mayo Clinic, 33 or 4.1 per cent died of cancer during a seven year period. In 1610 cases cited by Ewing,[33] the frequency was 2.2 per cent and he believes it quite possible that some of these were originally cancer.

Holmes and Hampton[34] showed that 87½ per cent of the prepyloric ulcers they studied at the Massachusetts General Hospital were malignant.

In one of the groups studied they found eight cases of prepyloric ulcer upon whom gastro-enterostomy was done, which were declared benign at operation. Later on all eight cases proved to be carcinoma. They concluded from their study, that all chronic, indurated, prepyloric ulcers should be considered malignant and treated by wide resection. They also said the same was true of chronic ulcers of the greater curvature, and probably those of the cardia as well. From the above findings it is evident that a large percentage of patients who die from gastric carcinoma can be cured by early surgery. There is no doubt that at present surgical removal is the only known cure for gastric carcinoma, yet comparatively few receive surgical treatment.

Balfour and Gray[35] state that one of the most interesting phenomena in the behavior of malignant processes of the stomach is the sharp line of demarcation of the lesion at the pylorus. For this reason an ulceration located definitely in the duodenum may be discounted as not malignant. On the other hand, too great emphasis cannot be placed on the possibility of malignancy in a lesion which is visualized on the proximal side of the pylorus. This is regardless of size or position. The impression has been widespread that gastric carcinoma exists only in the presence of anacidity. Benign lesions of the stomach may exist with very low acidity; malignant lesions are often observed in stomachs in which a relatively high degree of acidity is present. While dogmatic statements may be subject to criticism under many circumstances, particularly when dealing with the variabilities of diseases of man, in this instance dogmatism must have a place, for a lesion on the gastric side cannot be excluded as to malignancy or nonmalignancy except by operation. Under exceptional circumstances, an attempt to treat the condition conservatively is justifiable, but only under constant supervision. One characteristic of gastric ulcers is that the response is rapid to a well-planned medical regimen. Repeated x-ray observations should be made, and in the absence of improvement within two weeks, exploration should be advised.

It, therefore, seems logical that the surgeon should be influenced by the location of the gastric ulcer, because of the frequency of malignancy in certain areas. Gastric ulcers within one inch of the pylorus should be considered malignant until

proved otherwise. Early surgery should be advised or rigid medical treatment with frequent roentgenologic examinations for an indefinite period, regardless of apparent early clinical improvement. Very large ulcerations or ulcerations on the greater curvature should also be considered malignant. Scott[36] urges that all gastric ulcers be resected which do not respond, under strict medical management, by diminution of symptoms the first week, complete disappearance of symptoms and absence of occult blood in stools the second week, and disappearance of the filling defect by fluoroscopy by the end of the third week. Walters[37] advocates surgery for gastric ulcer in patients who have had a hemorrhage when the x-ray shows a crater, when the lesion is producing pyloric obstruction, and when the ulcer is near the pylorus or on the greater curvature.

The therapeutic test in which clinical, roentgenological and gastroscopic observation is conducted for a peirod of four weeks, during which time intensive medical treatment of the gastric lesion is carried out, has found a distinct place in the differential diagnosis of some of these gastric lesions. There is today unanimous opinion that when any doubt exists regarding the true nature of the lesion, surgical treatment is indicated.

Historical

The surgeons who planned and perfected stomach operations were courageous in attempting this pioneer work. The procedures bear many of the famous surgeons' names. The value of their contributions is immeasurable.

The first gastrectomy was performed by Péan[38] in 1878 for gastric carcinoma, followed by Rydygier[39] in 1880, but neither of these patients recovered. Billroth[40] performed the first successful gastric resection in 1881. The technique used in these first three gastric resections was the same, in that the narrowed stump of the stomach was united with the duodenum. This procedure became known as the "Billroth I" method.

Wölfler,[41] at the suggestion of his assistant, Nicoladoni, introduced gastro-enterostomy the same year Billroth performed his first resection of the stomach. It was an anterior anti-peristaltic gastro-enterostomy.

Curvoisier,[42] in 1883, proposed posterior gastroenterostomy. The posterior surface of the stomach was exposed through a transverse division of the mesocolon and either the duodenojejunal flexure or the first portion of the jejunum was utilized in the anastomosis. Von Hacker,[43] in 1885, improved on the method of Curvoisier, by tearing through the mesocolon and using the jejunum at a point twenty to twenty-five cm. from the duodenojejunal flexure for attachment to the stomach. The same year Billroth operated upon a patient in whom he found a large cancer of the stomach. In Billroth's opinion it was thought inadvisable due to the patient's poor condition, to extirpate the tumor, therefore, he performed a gastro-enterostomy. The patient withstood this operation so well that Billroth decided he could withstand removal of the tumor as well. He subsequently removed the tumor and closed the lines of resection of the stomach and duodenum. This became known as the "Billroth II" method.

Hofmeister,[44] in 1888, advised closing the upper portion of the cut end of the stomach and used only the lower portion in establishing continuity with the jejunum, following partial gastric resection.

Lauenstein, as early as 1890, suggested anastomosis between the afferent and efferent loops of jejunum in order to drain the dependent portion of the proximal loop and thus avoid regurgitation. This was first done by Braun and Jaboulay[45] in 1892. Subsequently, surgeons found the method particularly useful where the proximal loop is unusually long, as in the anticolic type of anastomosis, and it has been used extensively. In this same year Murphy reported his epoch-making work in the production of cholecysto-intestinal, gastro-intestinal and entero-intestinal anastomosis and approximation without sutures "by means of a special button."

Jaboulay, in 1894, performed the operation of gastro-duodenostomy and a year later the operation was performed independently by Kummell.

Two interesting contributions were made in 1898 when Schoemaker introduced a modification of the Billroth I procedure for partial resection. This operation was accomplished by means of a special clamp with two widely-angled blades, which so gripped the stomach that a large portion of the lesser curvature and a smaller portion of the greater curvature were removed. The upper arm of the angle was closed and the smaller open-

ing, which was left between the lower angles, was then united directly to the cut end of the duodenum. The same year Roux performed the Y-shaped gastro-enterostomy. He divided the jejunum completely, implanted the distal end in the stomach and the proximal end into the side of the distal end. The hepatic and pancreatic secretions were then admitted to the jejunum at a distance of about 7.5 cm. distal to the site of the gastro-intestinal anastomosis and were, therefore, less likely to enter the stomach and cause vomiting. In the light of recent experimental work on the physiologic aspects of secondary ulceration, the fact that there was a considerable length of jejunum which was not being reached by the alkaline secretions from the liver and pancreas, undoubtedly accounts for the high frequency of secondary ulceration near the anastomosis in these cases.

The Billroth II method for resection of the stomach was found to be impractical in cases where large portions of the stomach had to be resected. It was found that the remaining stomach stump was too small to occlude by this operation because it left no room for a gastro-enterostomy. Polya,[46] in 1911, devised a new technic for overcoming this difficulty in which he closed the cut end of the duodenum, brought up a loop of jejunum through the mesocolon and performed an end-to-side anastomosis with the cut end of the stomach.

Balfour, in 1917, advised utilizing a long loop of jejunum which he brought up anterior to the colon, and mentioned the advisability of making an entero-anastomosis at the dependent part of the afferent loop in cases with low acidity. Von Haberer and Finney,[47] in 1922 and 1924 respectively, suggested closing the cut end of the duodenum and making an end-to-side anastomosis between the stomach and the second portion of the duodenum. Moynihan utilized the Y principle of Roux but the objection to this method was the necessity of many lines of suture.

Innumerable contributions, in addition to those mentioned, have been made either in modifying some of these procedures or in suggestions as to improving the technic whereby the desired result might be obtained. In particular, the contributions of Moynihan and of W. J. and C. H. Mayo have been of outstanding merit in perfecting posterior gastro-enterostomy. W. J. Mayo has advocated the use of three rows of sutures in making the anastomosis and attached the jejunum to the stomach in an antiperistaltic line. The line of the anastomosis started just to the right of the angle on the posterior wall near the lesser curvature and continued obliquely across the posterior wall to a point just to the left of a vertical projection of the angle on the greater curvature. The proximal loop of jejunum was attached to the lesser curvature and the distal loop to the greater curvature and in this way was not interrupted at the flexure. The rent in the mesocolon was sutured to the stomach, slightly away from the anastomosis. The loop in these cases was 2.5 to 7 cm. long.

PYLOROPLASTY: Heineke, in 1886, performed the first plastic operation for relief of a benign stricture of the pylorus. Mikulicz,[48] working independently and without knowledge of Heineke's work, described a similar operation. The operation has been known subsequently as the Heineke-Mikulicz pyloroplasty. Rydygier, in 1887, suggested resection of the bleeding ulcer by means of pyloroplasty.

Kocher, in 1891, performed end-to-side gastro-duodenostomy following pylorectomy. Jaboulay, in 1889, performed submucous pyloroplasty, which was later popularized by Ramstedt and has been known as his operation for congenital stenosis of the pylorus.

Richardson, in 1899, Morrison, in 1900 and Mayo-Robson, in 1901 each described modifications of the Heineke-Mikulicz pyloroplasty and reported several successful cases. Halstead, in 1901, described a new modification using a lateral anastomosis from which Finney, in 1902, worked out the pyloroplasty that today bears his name.

Prior to 1914 the most popular procedure for inflammatory lesions of the stomach and duodenum was gastro-enterostomy. A few ulcers had been excised by use of the knife but Balfour, in 1914, recommended and used the electric cautery for the excision. Horsley,[49] in 1919, used a new pyloroplasty with a straight incision, excised the ulcer if possible and closed the incision in a transverse direction using only the gastric tissue.

Strauss, in 1921, modified this method by making the incision in the shape of a tongue, through the pyloric muscle, excising the ulcer and anastomosing the two areas together.

Judd, in 1923, described a modification in which he excised the ulcer and continued the incision so as to explore the posterior wall. The ulcer was included in two semilunar incisions, the ends of which joined. The upper incision was placed so that the middle lay opposite the center of the pyloric ring with its convexity upward. The lower incision was similarly placed but with its convexity downward. The closure was accomplished in layers in the same direction.

C. H. Mayo,[50] in 1924, introduced the large flap gastro-duodenostomy instead of the narrow flap of Finney but so adapted it as to excise the anterior pyloric ulcer, either low in the stomach or in the dudodenum. More extensive use of the cautery was recommended when the lesion was situated on the posterior wall. Rarely does a year pass without some modification being added to the listed procedures but they are too numerous to recapitulate in detail.

Surgical Treatment

The primary purposes of operation for peptic ulcer are to relieve the symptoms, to protect the patient against complication of ulcer, to restore him to his usual efficiency and to enable him to live normally. The methods by which these purposes may be achieved vary greatly and no one method may be applied to all cases. Surgical procedures for duodenal and gastric ulcer, curative in purpose, are of three general types: (1) Plastic operation on the pylorus with or without excision of the ulcer; (2) the indirect operations of gastro-enterostomy and gastro-duodenostomy with or without excision of the ulcer; and (3) gastric resection with one method or another of restoring gastrointestinal continuity.

It is apparent that the surgeon must be prepared to carry out a variety of operations in the treatment of peptic ulcer, depending on the individual case. The general condition may be greatly affected by such complications as hemorrhage or perforation, with resultant shock which would restrict the extent of surgical intervention. Such local conditions as dense adhesions might limit the extent of operative procedure. The surgeon should be guided directly by the condition of the patient and what he finds in each individual case and apply the operation which is most appropriate and expedient.

Excision of the Ulcer

Simple excision of a peptic ulcer is an operation which a surgeon rarely performs at the present time, due to the high incidence of recurrence of ulceration following this procedure. This is also true of cautery destruction of an ulcer. Knife or cautery excision does not provide for the alteration of gastric function and gastric acidity required for protection against recurrent ulceration. About 90 per cent of peptic ulcers occur at or near the pylorus or along the lesser curvature and the danger of stenosis attending simple excision in this location is great. It is used for small benign lesions when the patient's general condition precludes a more extensive operation. It is obvious that simple excision of ulcers which are located on the anterior or posterior wall of the body of the stomach is rarely performed. Excision of a perforated ulcer is sometimes done for diagnosis.

Pyloroplasty

There are many types of pyloroplasty. The oldest of these is the Heineke-Mikulicz pyloroplasty. The procedure consists in dividing the strictured area in a line parallel with the axis of the viscus and suturing the incision transversely. The objections to this operation are that it may be followed by a recurrence of the stenosis or the formation of a pouch. The Heineke-Mikulicz operation done for an ulcer without stenosis may not be so objectionable as it would be in one with stenosis, but it produces a pouch. The type of pyloroplasty devised by Finney, which is really a gastro-duodenostomy, overcomes those objections because the anastomosis between the stomach and duodenum is made below the limits of the stenosis and is in new and healthy tissue.

Horsley uses a physiologic type of pyloroplasty where there is a small limited ulcer in the first part of the duodenum and with certain types of small pre-pyloric ulcers, and when it is desired to give rest to the stomach after excision of a small gastric ulcer in other regions with apparent good results. He makes an incision about midway between the greater and lesser curvatures of the stomach, beginning one and one-half or two inches from the pylorus. The point of the beginning of the incision depends upon the location of the lesion. If the ulcer requires an incision of one inch in the duodenum,

the incision in the stomach must be at least two inches. He keeps a ratio so that the portion of the incision in the stomach is at least twice as long as the incision in the duodenum. The incision is then sutured transversely. In a series of sixty-eight cases Horsely had three deaths and fourteen recurrences of the ulcer. This operation is founded not upon a plastic principle, but upon a principle of correcting or extirpating the pathologic process as far as possible and of giving physiologic rest. In border-line cases it would seem better to do a pyloroplasty than a gastro-enterostomy, because if a secondary operation has to be done it is easier to to deal with a recurrent ulcer after pyloroplasty than with a jejunal ulcer after gastro-enterostomy. Judd's modification of the Horsely operation gives good results in selected cases. Excision of the anterior wall of the duodenum together with a portion of the pyloric muscle is of distinct advantage when it is necessary to visualize the posterior wall. Occasionally, clear evidence of an anterior lesion is lacking and the history and x-ray evidence is positive for ulcer. Unless the posterior wall is examined, it is impossible to determine with exactness the presence or absence of ulceration.

Balfour and Gray have found the cautery to be of particular value for lesions in this situation. They also state, that in general, unless there is definite pyloric obstruction of long standing, excision of a duodenal ulcer with a portion of the pyloric muscle and plastic reconstruction of the pyloric orifice should be done.

Gastro-duodenostomy

Gastro-duodenostomy has gradually supplanted the simple Heineke-Milulicz type of pyloroplasty with its various modifications because of its greater application. Hunt[21] describes a procedure in which he modifies the lateral anastomosis of Jaboulay so as to utilize the second and third positions of the duodenum. His method can be used in certain cases of duodenal ulcer as a primary operation. It may, also, be employed as a conservative operation instead of gastrectomy after taking down a gastro-enterostomy and excision of a gastrojejunal or jejunal ulcer.

Gastro-enterostomy

Gastro-enterostomy was one of the first of the standard operations on the stomach. In this country, it is still the most popular of the indirect operations, and when performed with adequate indication, will bring about permanently excellent results in a fair percentage of cases. An added advantage of this procedure is that if the operation fails in its purpose and for any reason further surgical procedures are necessary, the gastro-enterostomy may be disconnected with relatively little difficulty.

Posterior gastro-enterostomy will give excellent results if it is done in such a manner that the proximal loop of jejunum is attached to the right of the angle of the stomach on the lesser curvature, and the distal loop on the greater curvature slightly to the left. A loop of jejunum of sufficient length to allow freedom of movement but with no excess, should be utilized. Suture of the transverse mesocolon to the stomach near the line of anastomosis will prevent a loop of bowel from projecting into the lesser peritoneal sac and will prevent retraction of the anastomosis with subsequent kinking and obstruction to the distal loop of jejunum. In cases in which the mesocolon is short and contains considerable fat, anterior gastro-enterostomy may be used. Occasionally an entero-enterostomy between the anterior loops is most useful.

Gastro-enterostomy may be indicated in cases with gastric retention due either to cicatricial pyloric stenosis secondary to chronic duodenal ulcer, or to loss of gastric motility in certain cases of gastric ulcer and in other instances following local excision of a gastric ulcer. The results of gastro-enterostomy in the cases of true cicatricial pyloric stenosis of duodenal ulcer are the most brilliant in gastro-duodenal surgery, from the standpoint not only of ultimate results, but also of mortality. However, experience by many has shown conclusively that gastro-enterostomy may not be employed with similar success in other cases of duodenal ulcer and its complications.

Gastro-enterostomy can be performed with little risk under certain circumstances in which the risk of any other operation might be great and not justified. Gastro-enterostomy continues to be most useful as an adjunct to conservative local excision of a gastric ulcer.

If a local excision of a pyloric ulcer is performed, and the ensuing closure may obliterate the pyloric orifice, and unless combined with pyloroplasty, gastro-enterostomy must be performed. Gastro-enterostomy with a nearly obstructed pylorus will, as a rule, be more efficient and give better clinical results than one performed in the presence of a patent pylorus.

Occasionally gastro-enterostomy may be indicated for gastric lesions, though as a rule other procedures are preferable in ulcer of the stomach.

The indications for gastro-enterostomy and for pyloroplasty in duodenal lesions constitute two fields which tend to merge into each other. When an ulcer is in the first inch of the duodenum, its usual location, when it is rather small and accompanied by no adhesions; or when there is a very narrow stricture of the duodenum at the pylorus, a pyloroplasty of the physiologic type may be indicated along with excision of the ulcer. The Finney pyloroplasty can be done more satisfactorily in the presence of adhesions and stenosis than the physiologic pyloroplasty, but in any pyloroplasty where the adhesions are extensive there may be a recurrence of the symptoms.

Lahey[16] believes that gastro-enterostomy is not a desirable operation and should not be applied routinely to patients with duodenal ulcer. If the patient is a bad risk it is better to have him alive with gastro-enterostomy, even if the incidence of a subsequent gastro-jejunal ulcer is 16 per cent, than to submit him to a more ideal operative procedure that has a hazard, in cases not acceptable for partial gastrectomy, which is altogether too great to be reasonably accepted.

Posterior gastro-enterostomy is discredited in the treatment of the bleeding case in recent literature. Walters[37] states that gastro-enterostomy will protect the patient against recurrence of hemorrhage in 83 per cent of the cases, and, should hemorrhage recur, it is seldom of serious import. Westermann[51] reports seventeen patients with bleeding ulcer on whom a gastro-enterostomy was performed and who later developed recurrent hemorrhage. Lewisohn[52] believes that a posterior gastro-enterostomy is absolutely futile in bleeding gastro-duodenal ulcers. Hinton[53] states that thirteen of the 123 bleeding ulcer patients seen at Bellevue Hospital had a previous posterior gastro-enterostomy. Many others believe that posterior gastro-enterostomy does not protect the bleeding case permanently from a recurrent hemorrhage. According to Goldman,[54] thirty patients in his series had gross hemorrhage from an ulcer after gastro-enterostomy. He advocates removal of the ulcer in addition to a subtotal gastrectomy after the method of Allen and Benedict.[55]

With gastro-enterostomy generally accepted as inadequate in the treatment of hemorrhage, there has been a trend toward radical gastric resection after the teaching of Finsterer.[56] He reports a mortality of 4.3 per cent for early resection in massive hemorrhage. This figure goes to 32.7 per cent when operation is delayed by a trial of medical treatment. He insists that surgical therapy should be instituted within forty-eight hours of the initial massive hemorrhage.

About the same results are reported for the exclusion operation as for gastro-enterostomy. Allen[57] reports disappointing results in fifteen patients in whom the antrum was transected and a posterior gastro-enterostomy was carried out. He abandoned this type of procedure for radical resection with removal of one-third to two-thirds of the distal portion of the stomach as well as the ulcer-bearing portion of the duodenum when possible. He has carried out this operation without a fatality in thirty-eight consecutive cases of posterior wall duodenal ulcer.

Pyloric Occlusion with Gastro-Enterostomy

This operation is now rarely performed but it still has advocates. Horsley uses this procedure in lesions which seem to call for gastro-enterostomy, such as a large or infiltrating ulcer, stenosis, or an ulcer with numerous adhesions and feels that the pyloric end of the stomach usually should be occluded entirely. Walton uses it in performing a wedge resection of the stomach when the ulcer is on the lesser curvature; the operation being followed by a temporary occlusion of the pylorus and a gastro-enterostomy. Horsley's basis for the operation is that it gives physiologic rest by completely diverting the gastric contents from the lesion in the duodenum, thus affording an opportunity for healing that could not occur if the duodenum continued to function as a channel for food. Walton's reason is that this method in his hands gives most satisfactory results.

Gastrectomy

Partial or subtotal gastrectomy has for many years been the operation of choice for the treatment of duodenal ulcer in continental Europe, while in England and America most surgeons employ gastro-enterostomy.

Since 1933, when Fogelson[58] first presented a review of the literature on medical treatment of gastroduodenal ulcerative disease, and called attention to the excellent results obtained with gastrectomy by European surgeons, there has been a steady acceptance of this method of treatment of peptic ulcer in this country and England. Ogilvie

in England, Graham in Canada, Hinton, Lahey, Priestly, Eiss, Lewisohn, Cutler and Zollinger and many others have published reports during the past year of its effectiveness in the treatment of peptic ulcers.

Lahey[16] states that previous to 1930, at the Lahey Clinic, three resections were performed to every seven conservative operations in all types of ulcer, gastric and duodenal. Today in duodenal ulcers seven resections are performed to every three conservative operations. In the last ten years the figures for conservative and radical operation have been completely reversed.

Priestly,[3] Mayo Clinic, December 20, 1939, reported three hundred and thirty-two patients with duodenal ulcer in which gastro-enterostomy was employed in 60 per cent and gastric resection in 30 per cent of the cases. It is obvious that gastro-enterostomy still maintains a very definite place in the surgical treatment of benign ulcer. During each of the last few years the incidence of partial gastrectomy gradually has been increased. This increase has occurred for the most part at the expense of plastic operations on the outlet of the stomach which have decreased in frequency in about equal proportions to the increase in the incidence of gastric resection.

Gastrectomy whether subtotal or partial has advanced to an important position in the treatment of duodenal ulcer. The frequency with which gastro-enterostomy and other conservative operations have failed to provide assurance against subsequent bleeding in the hemorrhagic duodenal ulcer, has led to the general acceptance of the policy to attack the ulcer directly and remove it with the resected stomach. Likewise, in the ulcer which has perforated, particularly in those instances in which the pancreas has been penetrated and a crater ulcer exists, experience has proved that partial gastrectomy facilitates either excision or exclusion of the lesion with eminently good results.

The treatment of gastric ulcer is on a different basis from that of duodenal ulcer. It is unwise to assume that any lesion in the stomach is benign. The usual treatment, therefore, should consist of removal of the lesion and an operation adequately adapted to establish and maintain drainage of the stomach.

Partial or subtotal gastrectomy is applicable in many cases of gastric ulcer, particularly in those instances in which the ulcer is situated in the py-loric half. In performing gastrectomy for gastric ulcer, the safety of the operation is materially enhanced if the duodenum is avoided and the resection is limited distally by the pyloric ring. Because of the frequency with which a posterior anastomotic ulcer has followed the segmental or sleeve resection with end-to-end anastomosis of the two segments, this type of operation is practically never used. In performing gastrectomy for peptic ulcer the magnitude of the resection determines which one of the various types of gastrointestinal restoration is most easily applicable, and of these the Polya, Balfour-Polya, Billroth I and II, and the various modifications of Finsterer, Hofmeister, and Haberer are those most frequently employed. In 1938 Priestly reported a series of gastric ulcer cases in which the posterior Polya type of operation was performed in 70 per cent of the patients.

Clagett,[59] Mayo Clinic, in 1939 reviews a series of 272 patients with chronic gastric ulcer who were treated surgically from 1933 to 1937. Most of the chronic benign ulcers were situated along the lesser curvature in the vinicity of the angle of the stomach. They were operated by various methods with a mortality of 5.9 per cent; posterior Polya resections in 131, anterior Polya resections in 9, Billroth I resections in 22, excision of gastric ulcer by knife or cautery combined with gastro-enterostomy in 50, segmental or sleeve resection in 10, knife or cautery excision in 14, gastro-enterostomy in 21, pyloroplasty with excision of gastric ulcer in 9, gastro-gastrostomy in 1, gastrectomy in 1.

The advantages of the Polya type of resection lies in the fact that this procedure removes the lesion and also provides maximal protection against recurrence of ulceration. The procedure may not be advisable if the lesion is so high that resection is not technically feasible or if the patient's condition does not warrant such an extensive procedure.

The possibility that a gastric ulcer may be malignant, although there are no gross changes characteristic of malignancy, often renders advisable a fairly radical removal of the ulcer and surrounding tissue. Billroth I resection was used only when the gastric ulcer was in the pyloric third of the stomach, and when the duodenum was large and mobile.

Excision of the gastric ulcer by knife or cautery combined with gastro-enterostomy was carried out in fifty instances. Excision of the gastric ulcer combined with gastro-enterostomy is a very satisfactory procedure since it accomplishes removal of the lesion and at the same time controls gastric acidity, thus protecting against recurrence of the lesion. The ulcer should be sufficiently small that excision can be performed readily. If conditions are such that excision combined with gastro-enterostomy is quite a formidable procedure, partial gastrectomy is preferable. In certain cases, particularly those with lesions lying high along the lesser curvature of the stomach, local excision associated with gastro-enterostomy may be the procedure of choice.

Segmental or sleeve resection of the portion of the stomach in which the lesion is situated adequately removes the ulcer itself but does not protect against subsequent ulceration and is sometimes accompanied by some disturbance of gastric peristalsis, so that it is less satisfactory than other procedures.

Gastro-enterostomy without excision of the ulcer is used when the patient's condition, age, or the high, inaccessible position of the ulcer prevents a more extensive procedure. It is not an operation of choice because it does not remove the lesion which may fail to heal after gastro-enterostomy. Moreover, the possibility remains that the lesion may be malignant.

Gastro-gastrostomy is often performed for hour-glass stomach caused by a chronic gastric ulcer. Total gastrectomy is occasionally performed for a large, high gastric ulcer.

Gastro-enterostomy or Gastrectomy

Eiss[60] writing on the "Surgical Management of Duodenal Ulcer" advocates gastric resection as the operation of choice, because it gives permanent relief and does away with unfavorable sequelae resulting from gastro-enterostomy. Where the condition of the patient is such as to preclude his withstanding a lengthy and highly technical operative procedure, gastro-enterostomy is resorted to as an emergency measure.

Eiss reminds us of two important steps which are worth mentioning. The first is that occasionally instead of first resecting the distal portion of the stomach and then completing the anastomosis as the final stage of a gastric resection, the procedure is reversed. When resection is left to the last and the condition of the patient precludes proper termination of the operation, the distal end can be rapidly closed. Resection and removal of this end of the stomach may be completed at some other time when the patient's condition allows. The second is that he frequently utilizes a Levine tube in the course of the operation. The tube is inserted a day or two before the operation for repeated lavage. When the stomach is resected the tube is pulled up a few inches from the operative field; after the anastomosis is completed the tube is pushed down into the jejunum for six inches and left in situ for about four days. This facilitates the administration of fluids and withdrawal of excessive secretions.

Church and Hinton,[61] after a statistical analysis of 106 cases of gastro-enterostomy for the treatment of chronic duodenal ulcers, conclude that the end results do not produce so favorable a view of this operative procedure as is generally presented by other writers. The analysis was based on a follow-up study of from one to twelve years, with an average of 7.1 years. It was found that of the 106 cases only 26 cases were cured, 24.5 per cent, 31 cases, 29.2 per cent, were benefited. By adding the cured to the improved cases it was found that 53.7 per cent of the patients who underwent gastro-enterostomy were helped by this procedure. There were 49 patients, 46.2 per cent, who were unimproved. Of the 106 patients operated upon, 17, 16 per cent, had second operations performed for recurrence of symptoms. Of the 106 cases, 20, 18.8 per cent, were found to have definite gastro-jejunal ulcers and 6, 5.6 per cent, had suggestive gastro-jejunal ulcers. Of the 106 cases, preoperative hemorrhage had occurred in 15, 14.1 per cent. In these 15 cases, 7 or almost one-half had postoperative hemorrhages. In 91 cases operated upon in the absence of preoperative hemorrhage, 15, 16.5 per cent, had post-operative hemorrhage.

Eleven years ago, quoting Hinton and Maier, [62] gastro-jejunostomy was the operation of choice. In 1933, a review of 79 gastro-jejunostomies followed for an average of four and one-half years, proved very discouraging; the incidence of marginal ulcer was found to be 16.4 per cent.

A more recent review of the results of gastro-jejunostomy gives a more dismal picture. Of 106 cases of gastro-jejunostomy followed for 7.1 years, 24.5 per cent only were cured; 29.2 per cent were reported improved, and 46.2 per cent as unimproved. Nearly half the patients who had been

subjected to this procedure found their condition unchanged or worse. Of the latter group, 18.8 per cent had gastro-jejunal ulcer and 7.5 per cent questionable gastro-jejunal ulcer.

As a consequence of these results, we have since 1933 submitted all chronic duodenal ulcers requiring operation to subtotal gastric resection. Fifty-seven resections have been performed, of which 39 were primary and 18 secondary operations.

Of the 57 cases in which resection was performed, 72.8 per cent had posterior ulcers; 15.5 per cent had both anterior and posterior ulcers, and in 11.7 per cent the ulcer was anterior only. Among the patients with posterior duodenal ulcer, definite chronic pancreatitis of varying severity existed in 73 per cent.

The pathologic changes in posterior duodenal ulcer are not fully appreciated unless a subtotal resection is performed, with removal of the ulcer from the head of the pancreas. To determine whether a duodenal lesion is an anterior or posterior ulcer is most difficult, since a single posterior duodenal ulcer can cause a deformity of the anterior portion of the duodenum that will give the appearance characteristic of an anterior ulcer. Subtotal resection definitely demonstrates the posterior lesion. The deformity is due to scar tissue in the muscular layers of the duodenum which probably explains the poor results frequently obtained in pyloroplasties for chronic duodenal ulcer. What is taken to be the ulcer is excised from the anterior portion of the duodenum but the real pathologic lesion (posterior) is left in situ. Even when an anterior ulcer is present, a posterior lesion often accompanies it.

In relatively late cases, pyloroplasty or gastro-jejunostomy is unlikely to be satisfactory: first, because it deals with a complication resulting from the ulcer rather than with a primary lesion; and second, because posterior duodenal ulcer is frequently left undiagnosed if a gastro-jejunostomy is performed. Only subtotal resection provides adequate diagnosis in these cases. More posterior ulcers were found in the group in which resection was performed; they were probably present in the others as well, but we had not been able to diagnose them.

A true organic obstruction from chronic duodenal ulcer usually indicates a definite posterior ulcer with radiating scar tissue in the duodenal wall, which has caused the stenosis. Pilcher,[63] in 1913, called attention to this type of duodenal stenosis when he said, "Posterior ulcers seldom perforate into the abdominal cavity, but are prone to inaugurate complications which, in the end, may prove quite as dangerous as an acute perforation, namely, pancreatitis, common duct obstruction and duodenal stenosis."

Pyloric obstruction without pain is due to spasm and can be alleviated by diet and medication. On the other hand, true stenosis of the duodenum with pain is a definite indication for subtotal resection. The ulcer in the posterior wall of the duodenum has perforated into the pancreas and caused chronic infection of that organ. Subtotal resection, not gastro-jejunostomy, is the proper method of attacking this condition.

When the incidence of operation in chronic duodenal ulcer is lowered to a point where only one in ten patients is operated upon, the results from gastro-jejunostomy or pyloroplasty will be most unsatisfactory, as emphasized by Cutler[64]. However, we are confronted with the problem of determining when the ulcer has ceased to be a simple, uncomplicated lesion and has become adherent to an adjacent viscus, usually the pancreas. If we had more means of detecting a chronic infection in the pancreas, we might be able to select patients requiring surgery with more accuracy than has been possible in the past. We are still forced to rely on the presence of atypical pain with radiation directly to the back as our best means of making the diagnosis. The pain is very severe as compared with typical ulcer pain, and requires sedatives and rest.

The most satisfactory method of attacking the complicated duodenal ulcer is a subtotal resection. It offers a reasonable low mortality—a mortality rate that compares favorably with that in other surgical procedures on the duodenum, such as pyloroplasty or gastro-jejunostomy. It offers a better chance of permanent cure than either of the above procedures.

Lewisohn[65] adopted partial gastrectomy in place of gastro-enterostomy because many patients not only remained unimproved but were made considerably worse by the latter operation. Conclusions were based on the fact that 18 per cent of the gastro-enterostomies had reoperations for gastro-jejunal ulcers and another 16 per cent presented definite clinical and roentgenologic evidence

of post-gastro-enterostomy disease. After[66] re-examination of an equal number of gastro-enterostomies and partial gastrectomies performed for duodenal ulcers, he found that the gastric resections showed hydrochloric acid anacidity below ten in 75 per cent of the cases, and that the gastro-enterostomies showed anacidity in only 4 per cent of the cases. In the majority of gastro-enterostomies the post-operative acid figures were not lower than those obtained before operation. He concludes by saying that when a series of medical treatments have failed, partial gastrectomy affords the best measure at our disposal. It relieves the patients of many years of suffering, safeguards them against the serious complications of perforation and hemorrhage, and effects a permanent cure in about 90 per cent of the cases.

Westermann[51] feels that the majority of surgeons are opposed to posterior gastro-enterostomy in the treatment of chronic duodenal ulcer because it is followed by jejunal ulcer. He defends gastro-enterostomy by quoting Finsterer's[67] report of jejunal ulcers following partial gastrectomy and adds that subtotal gastric resection is not immune to this complication. He also points out that in many of the reports in favor of gastric resection, the authors make no distinction between partial and subtotal gastric resection. He is in favor of subtotal gastrectomy, specifically the removal of all but the fundus of the stomach, with fundojejunal anastomosis. He further points out that subtotal resection involves a serious risk and is occasionally followed by jejunal ulcer. Posterior gastro-enterostomy has met the requirements sufficiently to justify him in the surgical management of duodenal ulcer. He makes a point of placing the stoma high in the body of the stomach.

He limits the application of posterior gastro-enterostomy to chronic ulcer of the duodenum without hemorrhage in which satisfactory non-operative treatment has failed. It is of no value in the bleeding type of ulcer. He is also opposed to the "resection for occlusion" procedure for bleeding ulcer. It is his experience, that gastro-enterostomy is satisfactory in the prevention of further hemorrhage but is followed by a high incidence of jejunal ulcer. Here subtotal resection offers the only chance for a permanent cure. He believes that posterior gastro-enterostomy has no place in the treatment of a gastric lesion and that anterior gastro-enterostomy should never be employed.

Walters[3] reports 108 partial gastrectomies and 202 gastro-enterostomies performed for duodenal ulcers in 1938 at Mayo Clinic. Twenty per cent of the 108 on whom partial gastrectomy was performed had an associated gastric ulcer. During the past few years there has been a tendency at the Clinic to do an increasing number of partial gastrectomies in patients with duodenal ulcer. This has been due partly to the fact that it is usually patients with complicated duodenal ulcers who are being operated on. Many of these patients have had bleeding and in many of them there is an unusually high degree of gastric acidity present. It is in this group of patients and in those of the latter part of the third decade and in the fourth and fifth decades of life that there is a place for the operation of partial gastrectomy when the condition of the patient or the size of the ulcer indicates that it and part of the stomach could be removed without appreciably greater increase in risk than that which might be expected to follow gastro-enterostomy. The risks involved in these two groups of cases were relatively equal. The risk of partial gastrectomy for duodenal ulcers, other things being equal, is directly connected with the size of the ulcer, its position, and the ability either to remove it leaving a sufficient amount of duodenum to close accurately or to leave it and have sufficient duodenum above the lesion to perform an accurate closure.

When careful consideration is given to the proper selection of cases for partial gastrectomy in duodenal ulcer, that a reasonable mortality rate can be obtained is evidenced further by the fact that in the recent report by Lewis of 212 cases of partial gastrectomy for duodenal ulcer, the mortality rate was 1.9 per cent. The same indications for the operation were used in the series of 1938 as in those which Lewis[68] and I reviewed. Four cases of anastomotic ulcer occurred in the 208 patients who recovered from the operation.

Eggers[69] is averse to subtotal resection in duodenal ulcer. He advocates resection when repeated massive hemorrhages have not been controlled, after failure of conservative operations, for intractable pain, and possibly for gastro-jejunal or jejunal ulcer.

Achlorhydria

Whatever the cause of ulcer may be, we are sure that it is kept alive by hyperacidity. This introduces factors of extreme importance in our conception, prognosis, and treatment of the disease;

that achlorhydria normally occurs in some persons, that the percentage increases with the years until, when we reach the age period of fifty to sixty years, 35 per cent of people have no free hydrochloric acid. It is obvious that whatever method of treatment is used, the prognosis is better in the older than in the younger group.

Production of post operative anacidity or low acid figure, free acid below 10, is the safest way to cure ulcer permanently. Neither gastro-enterostomy nor pyloroplastic operation assures this reduction in the acid figures. We should select that method which most frequently ensures a postoperative achlorhydria or at least marked reduction of the acid figures. The only method which produces this effect in the majority of cases is partial gastrectomy with removal of the lesion.

Marshall and Kiefer[70] state that unless anacidity or hypo-acidity is produced by high resection it is difficult to see any clinical advantage of this operation over gastro-enterostomy.

Lewisohn[71] states that pylorectomy or partial antrumectomy should not be called gastric resection, that these operations are attended by as high mortality as gastric resection and will be followed by high incidence of jejunal ulcer.

The term gastric resection is often incorrectly applied. Gastric resection means the removal of more than half of the stomach with removal of that part of the duodenum containing the ulcer. The Finsterer operation should be specified as such and not called gastric resection. A distinct and separate grouping of the Finsterer modification of a typical resection is of practical value. According to some authors, gastrojejunal ulcers after the Finsterer operation are more frequent, 15 per cent after the prepyloric resection, than after a typical partial gastrectomy, 7 per cent (Mage[72]) following the latter operation, and less frequent than after gastro-enterostomy, with about 30 per cent secondary ulcerations. The surgeon should distinguish between a prepyloric or a postpyloric Finsterer operation. When the pylorus is left in situ the incidence of gastrojejunal ulceration is higher than if the pyloric ring was removed at the operation. Finsterer never planned this operation as a routine procedure. He employed it whenever an ulcer is not resectable without too great a risk, in less than 5 per cent of cases of duodenal ulcer in Finsterer's series.

As Finsterer has shown, his method of resection should comprise removal of a large part of the stomach in order to compensate for the remaining pylorus. Maximum protection against recurrences requires a high resection. The Finsterer operation puts the ulcer at complete rest and considerably reduces the postoperative hyperacidity.

The same cannot be said of the palliative resection of Madlener[73] who applied a similar principle to high gastric ulcer. The postoperative results of Madlener's operation were most unsatisfactory and it is very infrequently employed at present.

There is another reason why pyloroplastics as well as gastro-enterostomies give unsatisfactory results; they do not change materially the acid values which existed before the operation. Clute and Sprague[74] conclude from their test-meal follow-up after gastroduodenostomy that "the total and free acid, from months to years after operation, was nearly as high as, or was higher than it had been before operation." It is an undisputed fact that duodenal ulcers occur and reoccur in the presence of high acid values and that they are practically unknown in the presence of low acid values or an anacidity.

The mortality following subtotal gastrectomy for gastric ulcer is usually higher than that following partial gastrectomy for duodenal ulcer, yet gastric resection for gastric ulcers is considered by most surgeons as a justifiable procedure whereas gastric resection for duodenal ulcers is considered too radical. The opposition is due to some extent to the abuse of the term subtotal gastrectomy in the treatment of duodenal ulcers, which infers that only a small stump of stomach is left behind. This term is fitting for the operation for high gastric ulcers. When dealing with duodenal or prepyloric ulcers the removed part represents a little more than one-half of the stomach, leaving a very considerable part in situ. Partial gastrectomy, not subtotal gastrectomy, is the correct term for this operation.

Priestley[75] observed that when an exclusion type of operation is performed for duodenal ulcer, severing the stomach at the most proximal portion of the pyloric antrum and inverting the pyloric end, then making a gastro-jejunostomy of some type, the ultimate results are not so satisfactory as when the pyloric portion of the stomach is removed. Likewise, when one performs resection

and severs the stomach proximal to the pylorus for a subacute perforating duodenal ulcer which cannot be readily removed, the ultimate results appear less favorable than when all of the pyloric portion of the stomach is excised. In other words, if gastric resection is to be performed for duodenal ulcer, it is probably advisable to remove all of the pyloric antrum.

Experimental and clinical evidence indicates that in performance of partial gastrectomy for duodenal ulcer it is essential to remove the pylorus if a maximal reduction of acidity is to be obtained. Ogilvie[76] reported recurring ulceration in three of twelve cases where partial gastrectomy without removal of the pylorus was performed for duodenal ulcer.

With some experience in gastric resection and with proper organization, the mortality in primary cases of gastro-duodenal ulcers should not be higher than 5 per cent. The point of contention is the relative desirability of gastro-enterostomy or subtotal gastrectomy. Many surgeons consider the latter procedure too radical for a condition that may be alleviated by simple gastro-enterostomy. However, experience has shown that in capable hands subtotal gastrectomy need present a mortality no higher than gastro-enterostomy. Ogilvie[77] states that a patient with a gastro-enterostomy may be happy but is never safe. Ulceration at or near the stoma follows in at least 20 per cent of the cases. Such a complication may require one of the most difficult technical operations in the realm of surgery attended by a mortality as high as 19 per cent. Ogilvie assumes that 5 per cent is a fair average for gastro-enterostomy mortality. However, if 18 per cent of the survivors develop marginal ulceration and ensuing operative procedures result in a mortality of 22 per cent, the total death rate following gastro-enterostomy will eventually be not 5 but 9 per cent. Therefore, subtotal gastrectomy in the hands of a skilled surgeon would eventually reduce the mortality by 4 per cent.

Ginzburg and Mage,[78] in a review of eighty-six cases of failures following gastro-enterostomy, stated that though an efficient stoma in the gastro-enterostomy tends to bring about the healing of an active duodenal ulcer, it also seems to favor the development of a marginal ulcer. They observed that the changes produced in an active duodenal ulcer by gastro-enterostomy produced not a cure but a remission of signs and symptoms.

In favor of subtotal gastrectomy it may be said that a patient is better off with a part of the stomach functioning normally than with the whole stomach functioning abnormally. Furthermore, the removal of that portion of the stomach which bears the greater percentage of acid-bearing glands eliminates to a decided extent one of the main provocative factors of ulcer formation. While anastomotic ulceration may also take place in subtotal gastrectomy when this occurs it is usually due to the fact that not enough of the acid-bearing area has been removed.

Lahey[79] has written: "In my mind jejunal ulcer is too frequent, too difficult and too dangerous a postoperative sequela for gastro-enterostomy to be employed as a routine method of treating duodenal ulcer."

Walton[80] points out that the experience of the majority of surgeons has shown that a partial gastrectomy is a more serious operation and has a higher primary mortality than that of gastro-enterostomy. In this respect statistics are so fallacious, for a surgeon who has done a considerable number of gastro-enterostomies and has then abandoned them for partial gastrectomy will show a relatively high mortality in his gastro-enterostomies while he was gaining experience, and a low mortality in the later operation of gastrectomy; whereas the surgeon who performs a partial gastrectomy only in the more serious cases which are probably carcinomatous will have in this group a relatively high mortality. The results of different methods are often a personal matter. One surgeon will become very skilled in one method and will get results which others fail to attain. Fogelson,[81] in his extensive review of the literature of gastro-duodenal ulcerative disease for the years 1934-1936 draws the conclusion that the surgeon himself should select that type of surgical intervention which in the light of his own previous experience has been most satisfactory to him.

The published results of a number of surgeons are extremely satisfactory. Finsterer,[82] for instance, reports a series of 407 cases with a total mortality of 4.4 per cent, while in the last 158 gastrectomies there were only three deaths, a mortality of 1.8 per cent.

Koennecke[83] reported 468 primary resections with a mortality of 1.5 per cent. Haberer[84] published a series of one hundred consecutive gastric resections for ulcer by the Billroth I method without a death.

Demel,[85] Abrumzant and Zabusova[86] have published a large series of cases with a mortality of about 3 per cent.

Gastrojejunal and Jejunal Ulcer

The most serious complication of gastro-enterostomy or some type of Billroth II operation is the postoperative formation of an ulceration around or near the anastomotic opening. It has been repeatedly emphasized in the literature that the best treatment of this complication is its prevention by more careful evaluation of the acid values and by more judicious selection of the initial operation.

Gastrojejunal or jejunal ulcer has been reported as from 1.7 to 24 per cent following gastro-enterostomy. The general average does not exceed 5 per cent. Judd and Hoerner,[87] reviewing a large series of gastrojejunal and jejunal ulcers, found that the symptoms appeared in 34 per cent of the cases within six months after gastro-enterostomy, and within one year in approximately 50 per cent of the cases. Grossman[88] reports the occurrence of jejunal ulcers from twelve to eighteen years after the original operation with seven of the twenty-three cases appearing after a lapse of five years. The location of the ulcer is recorded by Balfour[89] as marginal in 75 per cent of his cases and on the jejunum itself in 25 per cent.

In many instances satisfactory results followed gastro-enterostomy for many years with subsequent development of a jejunal or gastrojejunal ulcer. Variable as the incidence of gastrojejunal and jejunal ulcer may be, the new ulcer has proved to be of greater seriousness from the standpoint of complications and resistance to medical management as well as in the fact that the magnitude of surgical procedures necessary is greater than that of the gastro-enterostomy employed for the relief of the original ulcer.

Jejunal ulceration follows the exclusion operation next in frequency to gastro-enterostomy. Allen[90] carried out this procedure in fifteen cases and gave it up because of unsatisfactory results. A high incidence of jejunal ulceration is likely to occur with a long loop anterior gastro-enterostomy or when an entero-enterostomy has been performed in association with gastrojejunostomy. A similar type of ulceration may be found after gastro-duodenostomy. Turner,[91] in a series of forty-three cases of pyloroplasty, found a local recurrence in four cases.

Jejunal ulceration is not uncommon after inadequate resection and gastrojejunal anastomosis. The incidence of jejunal ulceration following resection is reported as 0.4 to 10 per cent.[92] Lahey and Marshall[93] report recurrent ulceration after subtotal gastrectomy in 7 per cent of their cases; Cutler[94] in 3 per cent; Lake,[95] in less than 2 per cent. Walton reports the occurrence of marginal ulceration in two cases following partial gastrectomy. Von Haberer[96] states that he has abandoned the Billroth II and Polya operations because he found gastrojejunal ulceration too common after their use.

The treatment of jejunal ulcer is both medical and surgical. Many cases with marginal ulceration following short-circuiting operations, although obstinate, can be entirely cured by adequate medical treatment. Medical treatment may fail to relieve the patient; there may be a free perforation or the unfortunate complication of a gastro-jejunocolic fistula may occur. Makkas,[97] in reviewing 131 cases of jejunal ulcer which penetrated into the peritoneal cavity, finds that jejunal ulcers perforate less often than gastrojejunal; that simple perforation usually results in a re-formation of the ulcer with a mortality of approximately 23 per cent; and that there was a mortality of 8.3 per cent in twenty-four cases treated radically. Judd and Hoerner in 597 cases of jejunal ulcer find a tendency toward perforation in 43 per cent. Law[98] recently reported perforation in a case of jejunal ulcer following partial gastrectomy.

There is some variety of opinion in regard to the surgical treatment of the jejunal ulcer which does not respond to medical treatment. Judd and Hoerner believe that the logical operation is taking down the gastrojejunal anastomosis and restoring normal continuity by a Billroth I type of operation. Additional partial gastrectomy is indicated in some of these patients. They find that only 6 per cent of the 597 cases treated required a second operation, regardless of the nature or extent of the primary surgical treatment of the jejunal lesion. Many believe that it is dangerous to restore normal continuity after jejunal ulceration lest there be a prompt return of the original ulcerative lesion. Lahey and Swinton, for instance, report 40 per cent recurrent duodenal ulcers in ten patients having restoration to normal continuity after resection of the jejunal ulcer. Ginzburg and Mage, studying

eighty-six resected specimens of postoperative jejunal ulceration, conclude that while a mechanically efficient stoma tends to bring about the healing of an active duodenal ulcer, it favors development of an anastomotic ulcer and disconnection of the gastro-enterostomy stoma because of anastomotic ulceration may result in re-activation of latent duodenal ulcers. For these reasons some type of resection is advocated. Bohmansson[99] advises a Billroth I operation as a routine treatment and has a mortality of 4 per cent in such cases without acute complication. Graham and Lewis[100] recommend a block resection of the stomach and jejunum with an end-to-end anastomosis of the jejunum and either a Billroth I or retrocolic Polya reconstruction of gastric continuity as the ideal procedure. The operative correction of a jejunal ulcer carries a rather high mortality. Finsterer[101] in 168 operations for jejunal ulcer reports a mortality of 11.3 per cent and Ogilvie a mortality of 19 per cent.

When surgery is carried out for jejunal ulcer an extensive gastric resection should be considered in an effort to control adequately the acid factor.

Gastro-jejunocolic Fistula

Gastro-jejunocolic fistula is a serious complication of jejunal ulcer. In an effort to avoid this complication, Lahey and Swinton urge that, if a gastro-enterostomy is to be carried out, it should be done at a point in the transverse mesocolon away from the transverse colon.

Rife[102] reports fourteen cases of gastro-jejunocolic fistulae appearing in a period of six months to eleven years after gastro-enterostomy for ulcer; for thirteen cases arising from ulcer there was a mortality of 20 per cent. Lahey and Swinton say that symptoms may occur in a few weeks to twenty-one years but about 50 per cent of the gastro-jejunocolic fistulas occur within two years of the original operation. They report a mortality of 63 per cent in nine cases, eight of which were operated upon. At the Massachusetts General Hospital, Allen[103] reports the incidence of postoperative gastro-jejunocolic fistula as approximately 14 per cent, the mortality in ten cases being 30 per cent.

Graham and Lewis consider that the ideal operation for gastro-jejunocolic fistula is block resection of the stomach, jejunum and colon and triple anastomoses together with cecostomy. Scrimger[104] reports a method of dividing the stomach above the opening in the jejunum. A cuff of stomach is cut one and one-half inches from the edge of the stoma, and its mucosa is dissected off the muscularis down to the edge of the ulcer until the stomach mucosa is removed. The stoma is then closed by suturing together the inner surfaces of the stomach cuff. The operation is completed by a gastro-enterostomy. But within two years the patient had a recurrence of jejunal ulcer. Another suggestion[92] is that the stomach be divided above the fistula and that the remaining portions be anastomosed with the jejunum. After a period of three to four weeks, when the patient has recovered, the remainder of the stomach is resected along with the fistula and the right colon. Allen reports a technique of aseptic repair of a gastro-jejunocolic fistula. A pair of long, thin Kocher clamps is applied about the stomach side of the stoma, and this wedge-shaped section of gastric wall is freed with a cautery. The stomach is closed following the Kerr aseptic technique. The involved portion of the transverse colon is resected as well with end-to-end anastomosis, following here again the Kerr aseptic technique.

Of course the subsequent problem in the management of the gastro-jejunocolic fistula is the maintenance of strict medical supervision to avoid re-activation of a jejunal or duodenal ulcer, depending upon whether or not normal continuity was established or some type of short-circuiting procedure was carried out.

Preoperative Treatment

Until relatively recently, interest in advances in surgical technic was definitely greater than that in the preoperative and postoperative treatment of patients. This condition has changed, and it is now realized that the operation is only a part of the treatment of the patient. The surgeon is no longer content simply to carry out technical procedures but is interested in the treatment of the patient from a broader viewpoint.

In uncomplicated cases of peptic ulcer in which operation is contemplated a satisfactory procedure is to admit the patient to the hospital the evening before the operation, so that he may have a restful night and become accustomed to his surroundings. Solid food is not given after 6 o'clock, the evening of admission and nothing by mouth after midnight. A small dose of one of the many available barbiturates usually is sufficient to induce quiet, normal sleep, and is of distinct advantage in lessening the apprehension prior to operation. About two hours

before operation a second dose of the same drug may be given. In the very nervous or apprehensive patient it may be necessary to give two doses an hour apart. About a half hour before operation ⅙ grain (0.01 Gm.) of morphine sulphate and 1/150 grain (0.5 mg.) of atropine sulphate should be administered, hypodermically. A Levine tube is placed in the stomach the morning of the operation and the stomach lavaged. If left in place during operation it may facilitate the operative procedure by keeping the stomach empty.

Complicated cases require special preoperative care as individually indicated. If there is pyloric obstruction, a careful check should be made of the chemical constituents of the body, which includes in particular the blood urea and blood chlorides. A determination of the carbon dioxide combining power of the blood gives added information relative to the presence of alkalosis. Evidence of alkalosis, as indicated by elevation of the blood urea and carbon dioxide combining power and a decrease in blood chlorides, should be combated energetically by intravenous medication. Two injections of 1,000 c.c. of a solution containing 10 per cent dextrose and 0.9 per cent sodium chloride every twenty-four hours effectively meets these requirements; one injection is given in the morning, and the other, late in the afternoon. The caloric requirement is maintained by the dextrose in the solution. Some surgeons administer fluids continuously but this method is tiresome to the patient and may cause thrombosis of the vein. Repeated aspiration of retained gastric secretion at least twice daily is necessary to insure satisfactory cleansing of the stomach and removal of all remnants of retained substances. Occasionally it may be necessary to keep an indwelling duodenal tube in the stomach for several days prior to operation.

If the patient is to reach the operating table with his stomach empty, it may be necessary to pass an indwelling duodenal tube into the stomach to which suction is applied for an hour prior to operation, throughout the operation, and for about seventy-two hours after operation. In patients with high grade pyloric obstruction, a large gastric tube is employed for washing the stomach prior to insertion of the duodenal tube. Keeping the stomach constantly empty during the induction of the anesthesia, throughout the operation, and during the early convalescence is the best assurance against pneumonia, and the surgical procedure on the stomach is much easier and gastric motility returns more quickly after the operation. Wangensteen[105] frequently employs feeding by Murphy drip into the stomach of boiled milk to which lactose has been added, 100 grams lactose to one liter of milk. This can be accomplished even though oral ingestion of two or three ounces at a time may be accompanied by vomiting or high grade retention. Another solution which affords a satisfactory means of supplying calories and protein is a mixture of forty grams of casein and two hundred grams of lactose in a liter of 0.45 saline solution. Wangensteen also supplies nitrogen by giving human plasma in 500 to 600 cubic centimeter amounts, half the quantity being given twice daily intravenously.

Satisfactory water and salt balance are determined best by giving enough fluid to insure a urine output of 800 to 1000 cubic centimeters a day, in which two to three grams of sodium chloride are excreted.

Vitamins B_1, C, and nicotinic acid are supplied in daily doses of 10, 50, and 100 milligrams hypodermically for a few days prior to operation and through a good portion of the postoperative period. Vitamin K should be given if there is a prothrombin deficiency.

Prolonged hemorrhage of small amounts is prone to cause profound anemia in the presence of which an operation is ill advised. An attempt should be made to improve the condition of the blood by general hygienic measures, rest, diet and by the oral administration of iron in one of its various forms. One or two transfusions are at times necessary prior to operation if anemia is extreme. A patient who has a concentration of hemoglobin of less than 40 per cent and less than 2,500,000 erythrocytes per cubic millimeter benefits from a preoperative transfusion.

It is of great advantage in any operation on the stomach, whether the patient is anemic or not, to determine the blood groups of the patient's relatives and to test their blood by means of the compliment fixation test to determine whether syphilitic infection is present and whether they may be used as donors if necessary. They should be in readiness at the hospital during the operation in case the patient should require a transfusion.

The patient with acute perforation of a duodenal or gastric ulcer usually requires immediate operation, a part of which is at least closure of the perforation. In such cases it is advantageous to

empty the stomach with a stomach tube before operation. If patients are in extreme shock, this should be combated by intravenous fluids and stimulants.

With the return to normal of the chemical constituents, which even in the most aggravated cases rarely requires longer than a week, operation may be performed.

Anesthesia

A correct estimate of the anesthesia problem in gastric surgery is more important than in many other fields. One needs relaxation for good exposure to correct adequately the situation at hand. There is no agreement as to the type of anesthesia which should be used or to the superiority of any one type. Local infiltration anesthesia is usually unsatisfactory because of the general distress of the patient and the marked abdominal rigidity. A large number of surgeons use nitrous oxide oxygen and ether. Wangensteen uses cyclopropane reenforced by ether with excellent results. Fallis[106] favors spinal anesthesia because he found a greatly reduced mortality rate in a series of cases. Ross[107] advocates the use of spinal anesthesia because he claims that it is a great factor in lowering the mortality. He used the following technic in 4000 cases. For upper abdominal operations in the average sized adult four c.c. of spinal fluid are withdrawn in which 120 mg. of novocaine crystals are dissolved to which one c.c. of nupercaine is added. It is felt that the height of anesthesia can be much better controlled by this method than when large amounts of dilute anesthetics are used. Allen[57] prefers splanchnic block as advocated by Finsterer[108] and modified by Ogilvie[109] and others. He uses Ogilvie's splanchnic needle and instills sixty c.c. of 1 per cent novocaine and 0.25 per cent quinine urea solution into the retroperitoneal tissues above the pancreas, between the aorta and the vena cava. Rienhoff[110] advocates the use of 100 c.c. of 1:3000 pontocaine solution for this purpose. Lahey[16] prefers 1:1500 nupercaine spinal anesthesia in from 16 to 20 c.c. depending on the height of the patient; 20 c.c. being the maximum dose. The use of nitrous oxide oxygen and ether with novocaine solution injected into the rectus muscle gives excellent relaxation for these cases. It appears logical that in the absence of agreement each surgeon should use the anesthesia to which he is most accustomed.

Postoperative Treatment

Injudicious postoperative care may cause inestimable harm in a case in which excellent operative procedures have been carried out. Every attempt should be made to avoid shock and pulmonary complications. Great care is observed to make certain that the indwelling tube is keeping the stomach empty. The use of the oxygen tent following prolonged gastric operations is advocated by Marshall. Patients are encouraged to move their arms and legs, to change their position, and to take deep breaths frequently.

Wangensteen advocates aspiration of the trachea with a urethral catheter at the termination of the operation through the larger diameter of the inlying intra-tracheal tube. If the trachea is moist, bronchoscopic aspiration is performed regularly before the patient leaves the operating room. He also advocates bedside weighing as a means of determination of the state of hydration.

The maintenance of a fluid balance so that intake exceeds output is important. This is accomplished by proctoclysis, subcutaneous and intravenous injection of fluids. Up to 3000 c.c. a day of 5 per cent glucose in saline is given. Water in sips is allowed by mouth after twenty-four hours. If edema develops, sodium chloride and serum protein determinations should be made, distilled water substituted for saline solution, and a low protein level raised by transfusion.

In the absence of retention of gastric contents the patient is allowed one-half ounce of water each hour, beginning forty-eight hours after operation, this is increased to one ounce an hour on the following day. A small quantity of milk is then allowed at frequent intervals, to which are added thin gruel and custard. The diet is slowly increased until the fourteenth day when a soft solid diet is started. Should there be a tendency to vomit, constant gastric suction is resumed and maintained for as long as is necessary.

A careful record should be kept of the amount of fluid removed from the stomach. The color of the fluid is important for if the fluid contains a large quantity of bile it means the anastomotic opening between the proximal loop of jejunum and the stomach is open whereas that between the stomach and the distal loop of jejunum is not.

It is important to observe the daily urinary output and specific gravity, for a low output may

mean insufficient fluid intake or retention of urine. If the former seems adequate even in the absence of ability to palpate a distended bladder, it may be advisable to catheterize the patient after voiding to eliminate the possibility that residual urine is present. If it is present, the patient should be catheterized every eight hours until it disappears. Some prefer the use of a retention catheter.

Many place no restrictions on the patient's diet when he leaves the hospital, inasmuch as achlorhydria is the objective when operation is performed for ulcer. Others place their patients on a restricted diet usually prescribed for ulcer patients to insure against subsequent difficulty, feeling that a careful medical regimen must be continued for an indefinite period.

Summary

Having decided that a duodenal ulcer falls into the small group which requires surgical treatment, the type of operation giving the best results is still much debated. When operation in indicated gastric resection is gaining ground for all types of peptic ulcer. In perforated duodenal ulcer the majority of surgeons feel that the best treatment is to close the ulcer and proceed no further. This may be proper when many hours have elapsed between perforation and operation or if the patient is in severe shock, but when the patient is in fairly good condition some surgeons feel it is not the best procedure. Frequently these patients will not be well until a second operation is performed. Pyloroplasties resection of ulcer, gastro-enterostomies, and gastric resections are being done in the presence of perforation. Yudin is a strong advocate of gastric resection. The surgeons obligation to a patient at the time when the ulcer perforates is to get him through alive. He should not be obligated to undertake such radical procedures as subtotal gastrectomy directed toward the removal of the ulcer and permanent cure of the condition. Not all patients with perforated duodenal ulcers can be operated on early enough so that the hazard to life itself from merely closing the ulcer is not considerable. One cannot add the risk of subtotal gastrectomy in the presence of a perforated ulcer without materially increasing the mortality rate. Many patients with perforated duodenal ulcers have never had a really adequate trial of medical management before the perforation occurred. Under these conditions one would subject a patient to a major surgical procedure without being certain that the ulcer could not have been managed medically after the perforation had been closed. It would appear then that a surgeon's first obligation is to save the patient's life by simple closure of the ulcer. His next obligation is to determine by an adequate trial of medical management after the patient has recovered from the perforation, whether the ulcer can be healed without operation. Then should medical management fail, a radical operation should be carried out if the patient's general condition and the location of the ulcer permit.

In dealing with chronic duodenal ulcer producing obstruction, the operative procedure depends on conditions found at operation. If the obstruction is at the pyloric sphincter, a pyloroplasty may be the most desirable operation. The results of gastroenterostomy in cases of obstruction are excellent. If the obstruction is far past the pyloric sphincter and perhaps adherent to the head of the pancreas a Billroth II type of resection would likely be the best operation. In either location of the ulcer if the patient is old and his condition poor, a gastro-enterostomy would be the operation of choice. Gastro-duodenostomy may be applicable to many cases of obstruction.

In the acute hemorrhaging type of duodenal ulcer many direct their attention, not to the ulcer, but to the hemorrhage, feeling that the results are better when one refrains from operation. There is a great difference in the prognosis in the young or those before middle life, and in the patients beyond middle life. In the former, spontaneous recovery is practically always the rule; in the latter it may not be. If operation for hemorrhage is to be undertaken the decision must be made within the first forty-eight hours, as it has been shown by Finsterer, Taylor and others that if operation is performed on patients who are having massive recurring hemorrhages from a duodenal ulcer after forty-eight hours, the mortality will be almost prohibitive. Recurrent hemorrhage should be sufficient cause for operation. In the hemorrhaging type of duodenal ulcer which requires surgery, a pyloroplasty and removal or suturing of the ulcer is usually the best operation. Finsterer, however, does gastric resection in these cases.

The consensus of opinion in the treatment of bleeding duodenal ulcer is to control the bleeding point in the poor risk patient and to keep in mind that hemostasis and not necessarily the permanent cure of the ulcer is the immediate goal. However,

whenever the general condition of the patient permits, a sufficient amount of the stomach may be removed to reduce the secretion of acid as well as to remove the ulcer-bearing area. Following this some type of gastrojejunal anastomosis is carried out. Ligation of the coronary arteries alone is insufficient to control the bleeding. Because of the danger of malignancy in gastric ulcer, excision of a liberal edge is advocated not only to control the bleeding but to permit adequate microscopic examination. Even the opponents of gastro-enterostomy in the treatment of duodenal ulcer believe that it may have a place in the treatment of gastric ulcer.

With failure of medical management it sometimes becomes difficult to make a decision as to advising operation. The individuals coming under this classification usually have severe pain which is not relieved by medication, rest, or diet, and which is without intervals of relief or periods of remission. These patients frequently have high acid values and usually have a penetrating ulcer of the posterior wall of the stomach. It is in this group that the arguments over conservative versus radical operative procedures is most heated. During the last two years the reports indicate strongly that the surgeons recommending radical procedures are more numerous. The operations most frequently recommended are those which are designed to reduce the acid content of the stomach and assure alkaline regurgitation into the stomach. The Billroth II type of operation or one of its many modifications is most frequently used.

Gastric lesions present a very different problem from duodenal lesions. In general, we can say that duodenal lesions are medical problems and that only complications require surgery, while gastric lesions are surgical problems. There are a few gastric lesions that will heal under medical treatment and remain healed. Because of these few medical cures a great many other gastric lesions are treated medically until the chance for a surgical cure has passed. The death rate from surgical removal of lesions that might heal under medical treatment would be very small but the death rate from malignant gastric lesions treated medically is appallingly large. That ulcers of the stomach may be the origin of carcinoma seems definitely established. The surgeon should be influenced by the location of the gastric ulcer because of the frequency of malignancy in certain areas. Gastric ulcers within one inch of the pylorus should be considered malignant

until proved otherwise. Early surgery should be advised or rigid medical treatment with frequent roentgenologic examinations for an indefinite period regardless of apparent early clinical improvement. Very large ulcerations or ulcerations on the greater curvature should be considered malignant. Scott[111] urges that all gastric ulcers be resected which do not respond, under strict medical management, by diminution of symptoms the first week, complete disappearance of symptoms and absence of occult blood in stools the second week, and disappearance of the filling defect by fluoroscopy by the end of the third week. Walters[122] advocates surgery for gastric ulcer in patients who have had a hemorrhage, when the x-ray shows a crater, when the lesion is producing pyloric obstruction, and when the ulcer is near the pylorus or on the greater curvature.

The therapeutic test in which clinical, roentgenological and gastroscopic observation is conducted for a period of four weeks, during which time intensive medical treatment of the gastric lesion is carried out, has found a distinct place in the differential diagnosis of some of these gastric lesions. There is today unanimous opinion that when any doubt exists regarding the true nature of the lesion, surgical treatment is indicated.

In no other condition does a surgeon encounter such marked variations in pathologic changes and in the general clinical manifestations of a malady as in the consideration of peptic ulcer.

The success of any operative procedure for peptic ulcer depends on many factors, most of which are under the control of the surgeon. Unsatisfactory results will occur, for no procedure is without risk nor does it insure one hundred per cent relief from symptoms and complete protection from further trouble.

To achieve the most in surgical treatment of duodenal and gastric ulcer, it is essential that the indications for operation be rigidly adhered to and that no operation be used as a routine procedure. Instead, the surgical procedure should be selected which most nearly meets the purpose of the intervention and which, after a thorough survey of the situation upon opening the abdomen, may be carried out with the maximum degree of safety.

A satisfactory result can not be obtained in all cases but with increased experience and knowledge, the percentage of failures in the surgical treatment of peptic ulcer should be reduced to a minimum.

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APPENDIX

Diets in use for Postoperative Care of
Peptic Ulcer Patients

BALFOUR'S POST GASTRIC DIET

Nothing by mouth for forty-eight hours. Water drams 1 to ounces ½ every hour on third day.

Fourth Day

8:00 Weak tea 100 c.c., no cream or sugar
10:00 Plain orange flavored gelatin ½ cup, no cream or sugar
12:00 Strained cream soup 100 c.c.
2:00 Milk 100 c.c.
4:00 Junket ½ cup
6:00 Gruel made with milk. ½ cup in all and 1 teaspoonful of sugar
8:00 Milk 60 c.c., cream 60 c.c.

Fifth Day

8:00 Cereal jelly 2 oz., with 50 c.c. of cream, 1 dram sugar
10:00 Custard or junket ½ cup
12:00 Cream soup 150 c.c.
2:00 Milk 100 c.c.
4:00 Plain orange flavored gelatin ½ cup
6:00 Cereal jelly 2 oz., with cream 50 c.c., 1 dram sugar
8:00 Milk 100 c.c., cream 50 c.c.

Sixth Day

8:00 Cereal jelly 3 oz., with cream 50 c.c., 1 dram sugar
10:00 Custard or junket
12:00 Cream soups 200 c.c.
2:00 Milk 100 c.c., cream 50 c.c.
4:00 Plain orange flavored gelatin ½ cup
6:00 Cereal jelly 3 oz., with 60 c.c. cream, 1 dram sugar
8:00 Milk 100 c.c., cream 50 c.c.

Seventh Day

8:00 Fine cooked cereal 3 oz., with 60 c.c. cream, 1 dram sugar, 1 soft cooked or poached egg
10:00 Custard or junket
12:00 200 c.c. cream soup, ½ slice dry toast, or two crackers
2:00 Plain gelatin flavored with fruit juices, ½ cup
4:00 Milk 100 c.c., cream 50 c.c.
6:00 Cereal (without bran) with 60 c.c. cream, 1 dram sugar, ½ slice dry toast
8:00 Milk 100 c.c., cream 50 c.c.

Eighth Day

8:00 Fine cooked cereal 4 oz., with cream 50 c.c., 1 dram sugar, 1 slice toast, ½ sq. butter and 1 soft egg
10:00 Milk 100 c.c., cream 50 c.c.
12:00 Cream soup, 1 slice toast or 2 crackers, ½ sq. butter, bland dessert (dessert choice): Custards, plain gelatin, blanc-mange pudding, simple ice cream or tapioca pudding
3:00 Cocoa or malted milk 150 c.c.
6:00 Cereal 3 oz., 60 c.c. cream, 1 dram sugar or milk toast plus same (½ canned pear) pear sauce
8:00 Milk 100 c.c., cream 50 c.c.

Ninth Day

8:00 Apple or pear sauce, 1 slice toast, ½ sq. butter, cereal 3 oz., 60 c.c. cream, 1 dram sugar, 1 soft cooked egg
10:00 Milk 100 c.c., cream 50 c.c.
12:00 Baked or mashed potato, vegetable puree, 1 slice toast, 1 sq. butter, bland dessert
3:00 Orange juice 100 c.c.
6:00 Cream soup 150 c.c., 1 slice dry toast, 1 sq. butter, baked, mashed or riced potatoes, pear or apple sauce
8:00 Milk 100 c.c., cream 50 c.c.

Tenth and Eleventh Days

Same as 9th day with the addition of cottage cheese or egg at 6 P. M.

Twelfth Day

8:00 Bland fruit, (stewed prunes without the skins), strained apple sauce, baked apples without the skin or seeds, baked banana, baked or stewed peaches, canned pear or canned apricots.
8:00 Cereal, cream and sugar, egg and toast, butter, beverage
10:00 1 glass of milk 1/5 of which is cream
12:00 Cream soup, chicken, or fish, small serving, Fish (white, haddock, halibut, blue, or pike.)
AVOID: Salmon, mackerel, herring, sardines, dried or smoked fish.
12:00 Potato, vegetable puree, toast, butter, bland dessert
3:00 1 glass milk, 1/5 cream
6:00 Creamed or riced potato, poached egg on toast, vegetable puree, bland fruit
8:00 1 glass milk

NOTE: Additions to the diet may be made from time to time, both in quantity and variety, depending on patient's condition. 1 tablespoonful of sweet orange juice may be added on the 5th day, increased from day to day until he is getting 4 tablespoonfuls by the 12th day.

FINNEY AND FRIEDENWOLD DIET

First Day:—First twelve hours:—Nothing by mouth; coffee and salt solution every four hours, alternating with continuous salt solution by Murphy drip. Fifteen hundred c.c. of salt solution by hypodermoclysis.

First Day:—Second twelve hours:—Small quantities of cracked ice by mouth. Salt solution infusion, repeated unless 1000 c.c. of fluid has been absorbed per rectum.

Second Day:—Water by mouth, gradually increasing to 30 c.c. every two hours. Proctoclysis continued. Salt solution infusion, depending on condition of patient.

Third Day:—Water, 30 c.c. alternating with egg albumin, 5 c.c. every hour.

Fourth and Fifth Days:—Gradually increasing water and albumin by mouth. Continued proctoclysis.

Sixth and Seventh Days:—Clear unflavored soup, dilute orange juice, increasing to 60 c.c. every two hours.

Eighth and Ninth Days:—Water as desired. Other fluids in 60 c.c. amounts every two hours. Proctoclysis is discontinued when water is given freely by mouth.

Tenth Day:—Soft boiled egg.

Eleventh Day:—Begin soft diet: hard toast, milk toast, cream of wheat, rice, baked potato, creamed chicken gradually added to diet up to

Fourteenth Day:—Restricted light diet during the third week.

The diet is then increased to that which shall be followed during the first six months. The following are gradually added, depending on the tolerance of the patient: any light soup, the more easily digested meats, chicken, sweetbreads, lamb, the white variety of fish, eggs in any form except fried, mashed and strained vegetables including potatoes, spinach, peas, beans, asparagus, and carrots; cereals, bread, excepting fresh and hot bread, stewed fruits, fatty food, cream, butter, and olive oil, any drinks except strong tea and coffee.

The following should be avoided: tobacco in any form, rich, coarse and fried food, and highly flavored food. More specifically, pork, corned meat, potted meat, liver and kidney, duck, goose, sausage, crab, lobster, salt fish, cauliflower, cabbage, tomatoes, beets, corn, salads, melons, berries, pineapple, pies, pastry, candy especially chocolate.

RHODE ISLAND HOSPITAL POST OPERATIVE DIET FOR GASTRIC CASES

First Day:—Nothing by mouth.
Second Day:—Nothing by mouth or 1 ounce water every ½ hour if ordered.
Third Day:—Feedings every hour.
  Albumin water 2 ounces and
  Cereal water 2 ounces alternating
Fourth Day:—Feedings every hour.
  Albumin water 2 ounces and
  Gruel (⅓ milk and ⅔ water) 2 ounces alternating
Fifth Day:—Feedings every 2 hours.
  Albumin water 2 ounces
  Gruel (½ milk and ½ water) 2 ounces
  Junket 2 ounces
Sixth and Seventh Days:—Feedings every 2 hours.
  Food the same as the 5th day, but increase amounts 1 oz. every day.
Eighth Day:—Feedings every 3 hours.
  Albumin water 5 ounces
  Gruel 5 ounces
  Junket
  Cream Soup 5 ounces
Ninth Day:—Feedings every 3 hours.
  Food the same as the 8th day, but increase feedings to 6 oz.
Tenth Day:—Feedings 6 per day.

Breakfast	Gruel
	Soft egg
	½ Piece of toast and butter
10 A. M.	Junket
Dinner	Cream Soup
	2 crackers and butter
	Custards or plain puddings
3 P. M.	Custard
Supper	Same as breakfast
8 P. M.	1 glass milk

Eleventh to Fifteenth Days:—Feedings 6 per day.

Breakfast	Pureed prunes
	Cream of wheat or strained oatmeal
	Cream
	Soft egg
	½ toast and butter
	Whole milk
10 A. M.	Malted milk
Dinner	Cream Soup
	Baked or mashed potato
	Plain pudding or ice cream
	½ toast and butter
	Whole milk
3 P. M.	Malted milk or weak chocolate milk
Supper	1 soft egg
	Baked potato, rice, cream of wheat or strained oatmeal with cream
	½ toast and butter
	Whole milk
	Pureed peaches, pears or apples
8 P. M.	Milk

Fifteenth Day:—Feedings.
  Increase toast
  Add strained vegetables such as carrots, peas, spinach, asparagus, squash, string beans, and beets.
  Add weak tea and coffee.

Important Rules to Follow:

1. Do not use cane sugar the 1st 6 days. Use milk sugar.
2. Serve small quantities of food often. Do not allow patients to overeat.
3. Use butter, sugar, and salt sparingly. Do not use pepper or other condiments.
4. Do not serve hot or cold foods or drinks.
5. Tobacco should be used in moderation if at all.

For home diet use printed diet marked "Discharged Ulcer Diet".

Call dietitian to give instructions.

RHODE ISLAND HOSPITAL DIET IN USE WHEN PEPTIC ULCER PATIENTS LEAVE THE HOSPITAL

Important Rules to Follow:

1. Eat small quantities of food often. NEVER OVEREAT.
2. Avoid condiments. This includes pepper, spices, and highly seasoned sauces. Use salt sparingly.
3. Avoid all acids. This includes vinegar, sour foods, lemons, tomatoes, etc.
4. Avoid excessive sweet foods.
5. Do not eat fried food, fresh breads or pastries.
6. Avoid very hot or very cold food or drinks.
7. Do not eat raw fruits or vegetables. They should be cooked.
8. Do not drink beer, wine or other alcoholic beverages.

Soups You May Have:
  All cream soups and oyster stew. No meat soups.
Meats You May Have:
  Chicken, lamb, lamb chops, scraped beef, crisp bacon; these may be broiled, boiled or creamed.
Fish and Eggs You May Have:
  All fish except smoked and fried.
  Eggs prepared any way except fried. Use 2 eggs daily.
Vegetables You May Have:
  Strained (put through a sieve) peas, carrots, beets, spinach, corn, asparagus, string beans, squash, pumpkin, celery.
  Potatoes; baked, mashed, creamed, boiled and scalloped. Rice, macaroni, spaghetti, noodles, plain and cream.
Breads You May Have:
  Stale white bread, toasted white bread, rusks, crackers, and zwieback.
Desserts You May Have:
  All soft puddings, custards, plain jello, ice cream, and sherbets containing no roughage such as nuts, cocoanuts, raisins, or other fruit.
  Strained (put through a sieve) apple sauce, peaches, pears, prunes, and apricots.
Beverages You May Have:
  Cocoa, malted milk, chocolate milk, milk shake, cabinets, eggnog, buttermilk, milk, cream, diluted grape juice.
  Diluted orange juice should be taken immediately after a meal two or three times a week. Tea or coffee may be used in moderation and chiefly as a means of changing the flavor of the milk and cream.
Cereals You May Have:
  Cream of wheat, farina, strained oatmeal, puffed rice, and cornflakes. Cooked are preferred to dry.
Dairy Products You May Have:
  Butter, cottage cheese, cream cheese, milk, and cream. From one to two quarts of milk should be taken daily.

SAMPLE MENU

Breakfast	Strained stewed prunes or apricots
	Strained oatmeal with top milk and
	1 teaspoon sugar
	Soft cooked egg
	Toast
	Cocoa
10 A. M.	1 cup milk and 2 crackers
Dinner	1 cup cream of carrot soup
	Minced chicken
	Mashed potatoes
	Strained potatoes
	Toast
	Tapioca pudding
	Weak tea with ½ milk
3 P. M.	1 cup malted milk
Supper	1 soft egg
	Baked potato
	Strained peas
	Toast
	Strained canned pears or apple sauce
	1 cup chocolate milk
8 P. M.	1 cup warm milk